PUBLIC WORKS

City, County and State

An Invitation

In recent months, hundreds of engineers and other public works officials have written PUBLIC WORKS for special information in connection with their work. And I am pleased to say that in most cases we were able to supply them promptly with what they needed.

This is as it should be because PUBLIC WORKS is a clearing house for all kinds of information concerning the design, construction and maintenance of public improvements. Its library contains most of the latest reports on all phases of public work. Its editorial staff comes in contact with the activities of the leading engineers in every section of the United States and has opportunities to learn of the successful solutions of many unusual engineering problems.

Much of the information which comes to this office is not published because it would not interest enough of our readers. But it is in our files, so we may have just the information YOU are looking for in connection with some special problem.

Therefore, if at any time you are in need of help in solving difficulties that arise in your work, you are cordially invited to write us about your problem. We shall be glad to do our best to assist you.

A. Prescott Folwell

Editor

NOVEMBER, 1935

Keep Your Highways Open

. with CLETRAC

THE way Cletrac handles snow removal work you'd think it was designed to specialize on this one job. But, of course, many of the Cletracs which will be keeping open the main highways, the town and city streets this winter, were doing just as good a job on road building and maintenance last summer.

Cletrac always delivers maximum usable power. Crawler traction does not stall in drifts—and controlled differential steering means power on both tracks and safety at all times.

Nine Cletrac models ranging from a special 22 h. p. model with 42" plow for sidewalk use up to 80 h. p. (40 and 80 h. p. also Diesel powered) make it possible to select the most practical and economical equipment for snow removal work.

Write for folder showing the many Cletrac features and the range of snow plow equipment available with Cletrac.

THE CLEVELAND TRACTOR CO.

CLEVELAND, OHIO

Cletrac Crawler Tractors
Built To Endure

VOL. 66 PUBLIC WORKS No. 11

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PUBLIC WORKS

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TIMEWASTERS

A "Squawkie" Problem:

A phonograph record is 12 inches in diameter at the outside track or groove; and the blank space at the middle is 2 inches in diameter. There are 250 tracks or grooves in the intervening space. How far does the needle of the standard phonograph move horizontally, in the playing of the record? Contributed by *A. S. Marlow.*

An Old-Timer from an Old-Timer:

A farmer in old Greece, realizing that the Grim Reaper was approaching, wished to leave his estate to either one or the other of his two sons who were equally worthy, and by direct question determined that both sons were agreeable to any plan which the father might have for disposal of his farm, goods and chattels. In due course the farmer died, and the pertinent portion of his will read as follows: "Let my elder son take the black horse from the barn, and my younger son the white, they to ride to Sparta. Whosoever's horse shall arrive in Sparta later shall inherit my estate." The elder son then took the black horse, as instructed, and the younger son the white, and they rode at a very leisurely gait towards Sparta, making many diversions and detours from the main road. Realizing that this procedure was unprofitable, they decided to place their problem before the Oracle at Delphi.

Both entered into the Temple of the Oracle together and stated their dilemma. Upon leaving the Temple, both sons were seen to hurry as rapidly as possible to the horses and to ride away at a rapid pace towards Sparta, as if in a race, which really was the case. What was the advice of the Oracle? Contributed by *Benjamin Eisner.*

That Sheet of Tin:

Bob Clark, having a new job out in Ohio, has not responded to our call for help on the tin box problem of last month. But George H. Whitfield, Director of Public Utilities, Richmond, Va., who is one of our top-notch solvers, writes in to say that his solution shows that maximum capacity is attained with H equal to 1.67 inches. The height being H, the length will be 15-2H, and the width 8-2H. The capacity will then be $4H^3-46H^2+120H$. By substituting values for H, a curve may be drawn showing the capacity. Thank you *Mr. Whitfield.*

The Unit of Angular Measure:

Mr. Bevan has worked out carefully the solution to the problem in the October issue on this subject. The solution is too long and too complicated to give here, but the unit angle for which five angles are numerically their own sine is 446° 17′ and 58″. This is a little too much for ye editor, Mr. Bevan, but probably child's play for some of our sharks.

Here's wishing a big turkey and an overfed Thanksgiving to you all. . . . W. A. H.

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A. PRESCOTT FOLWELL, *Editor* **W. A. HARDENBERGH,** *Asso. Editor*

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FOUNDED IN 1896

Traffic Moves when SNOW IS REMOVED

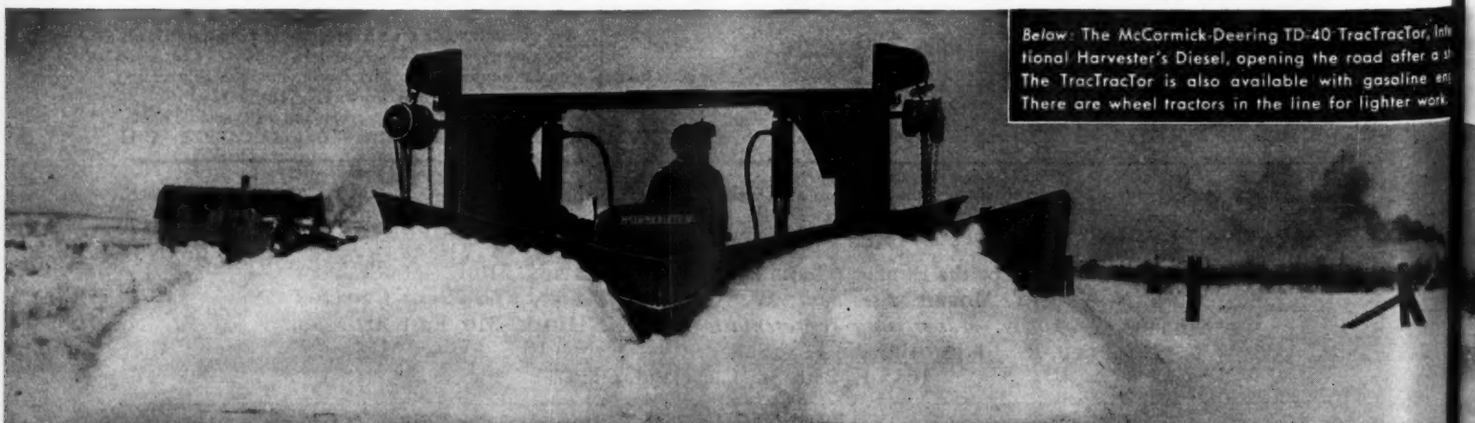
Above: The Model A-8 International Truck, shown a plowing through a big drift, does some of its most u work during the winter. Other sizes range from Half-Ton to powerful Six-Wheelers.

DEPENDABLE POWER is the key to a successful snow-removal program. And International Harvester is providing that kind of power in International Trucks and McCormick-Deering Industrial Tractors. These units are given more work in the snowbelt every winter, as those charged with keeping the roads and streets open find them exactly suited for the job. Their ability to handle any emergency that comes along... their stamina to stay on the job day after day and night after night... and their economy of operation have won the respect and admiration of everyone they work for. Should service be needed on International Trucks or McCormick-Deering Tractors, it is always close at hand—through a Company-owned branch, or a distributor or dealer. Before you go ahead with your plans for the winter, find out all about the power available in this International Harvester equipment.

INTERNATIONAL HARVESTER COMPANY
606 So. Michigan Ave. OF AMERICA (INCORPORATED) **Chicago, Illinois**

Assistant Engineer Solan, in charge of maintenance on Colorado's "Million Dollar" highway, a mountain road in the southwestern part of the state, says this about the TD-40 Diesel TracTracTor:

"We had ample opportunity to try out the TD-40 TracTracTor, as it snowed every day and I mean snow and plenty of drifts. The machine averaged 1.9 gallons of fuel per hour which cost 13¾ cents a gallon. A larger gasoline-powered tractor of greater rating on the same road used 4.1 gallons of gasoline per hour at a cost of 21½ cents a gallon. The TD-40 also could walk away from the other tractor pushing the same amount of snow on either Molas or Red Mountain Pass."



Below: The McCormick-Deering TD-40 TracTracTor, Inter tional Harvester's Diesel, opening the road after a st The TracTracTor is also available with gasoline en There are wheel tractors in the line for lighter work.

INTERNATIONAL HARVESTER

PUBLIC WORKS

City, County and State Engineering and Construction

Vol. 66 — *November, 1935* — No. 11

Snow Handling, East and West

Snow Handling in Idaho

By G. E. McKelvey

Commissioner of Public Works

IN IDAHO, snow handling has become a major factor in the maintenance of Federal and State highways. It is no longer optional—the public takes it for granted that the highways will be kept open under any and all conditions of weather.

The highways range in altitude from 750 to 8,700 ft.; the depth of snow from a few inches, on the plains, to 16 ft. in the mountains. Operations are confined chiefly to elevations between 2,000 and 5,000 ft. Last winter 3,300 miles of road were cleared. As a rule the state clears few county roads, but is called upon to rescue snow-bound bands of sheep and obstinate travelers who fail to heed signs.

The cost of removal is about 10% of the net gas tax collections, which are 70% lower in winter than in summer. That is, 10% of the gas tax is required to permit 30% of the regular traffic movement on the out-of-town highways. As maintenance crews are on the payroll all the time anyway, snow removal adds only the cost of fuel, oil and repairs during mild winters. The cost compared to income is about a standoff so far as highway funds are concerned.

The State equipment used for snow handling consists of

110 Trucks
132 Displacement plows for trucks
8 Rotary plows for trucks
7 Tractors
3 Displacement plows for tractors
4 Rotary plows for tractors
7 Graders
2 Power shovels
164 Miles of snow fence

The necessity for speed and economy in the removal of snow during general storms has directed attention to fast, powerful and relatively light equipment. There is being developed the idea of removing snow by the velocity at which the plow wings are moved through the snow rather than through mechanical lifting and rehandling. This has been accomplished with adjustable high wings and very simple and adaptable equipment has been developed.

Simplicity is so very essential that it should be better recognized. Manufacturers should standardize plow mountings, as it frequently happens that a truck and its particular plow are not at the same place when an emergency occurs.

The best snow remover is a high grade line of the road, as the wind does the work in open country.

Snow Fences

Snow fence constitutes one of the most effective and economical means of combating snow in the more open country, when placed in an understanding manner with due consideration to prevailing winds. Its placing and removal are accomplished under good weather conditions as compared to snow removal by mechanical means. Snow fence diverts snow from the road as it falls, while mechanical means remove it after it has accumulated. The accumulation period is the one during which traffic may be blocked and the large cost of mechanical removal begins.

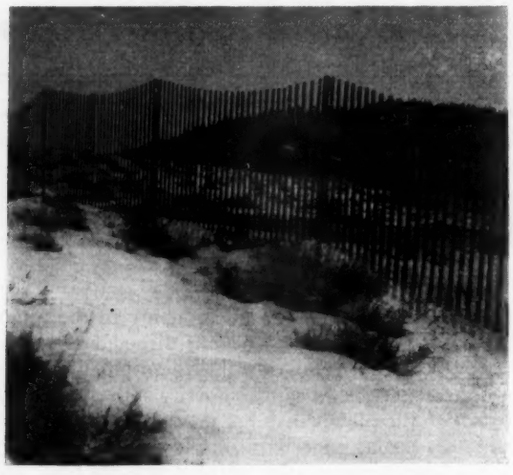
Under some conditions fence can be left in place the year around, subject of course to ground fires, its use for sheep corrals or as a back stop for rabbit drives by various residents.

The use of snow fence has in many cases greatly reduced the use of snow removal equipment and effected economies that are resulting in the use of more fence.

A rotary on a California highway

A Massachusetts road, January, 1935

Fencing of course has its particular points of efficiency. In the more barren, rolling and plains country, and in the valleys where the prevailing winds are fairly constant, it has given satisfaction. A cost of 2½ cents per foot for placing and removing justifies its growing use in favorable situations.



A four-foot snow fence in California

In Pontiac and La Crosse

The equipment used by the city of Pontiac, Mich., is described by Lewis M. Wrenn, city engineer, as follows:

"We use three motorized snow plows supplemented by several horse-drawn plows in deep snows, and attempt to have snow plowed from walks during the night so they are open by seven o'clock in the morning. Street plowing is also done as far as possible at night when automobiles are not parked on streets. Parking of cars at curbs creates a problem in snow plowing and removal. We prepare dry, sharp sand to which calcium chloride is added for sanding icy streets. This is spread from trucks by men with shovels.

"Our equipment for all of this work is very inadequate. For snow plowing we use 3- to 5-ton trucks with snow plow attachment. A Nelson snow loader is used to load snow from curbs where possible, otherwise snow is shoveled into small trucks by man power and dumped into the river at points where openings are maintained in bridges for this purpose. The 3 motorized sidewalk snow plows mentioned were built by our mechanics, using old Model A Ford motors and chassis.

"We do not contemplate purchasing any new or additional equipment due to lack of funds. We are one of the 15-mill tax limitation cities in Michigan, which has curtailed our operating budgets to a point below normal operating requirements."

La Crosse, Wis., according to City Engineer John H. Barth, uses for snow handling a 5-ton 4-wheel-drive truck equipped with snow plow; two long-wheelbase maintainers; also two tractors with graders when necessary. For hauling snow, the city rents all available trucks. With this outfit it finds itself adequately equipped.

Snow Handling in Massachusetts

In Massachusetts "There seems to be no question in the minds of any who are connected with snow removal work or of those connected with the automobile and truck industries and the associations of automobile and truck owners about snow removal paying," says A. W. Dean, chief engineer of the State's Department of Public Works. But as snow removal in that state began years ago, there are no comparative data for figuring the increase in revenue from gasoline tax because of this work.

The program started, as a state project, in 1927 with approximately 1,300 miles of highway approved for clearing and has increased each year until it is now over 1,800 miles. In the year ending Nov. 30th, 1934, the cost of this work to the state was $916,702, of which $15,549 was for plowing 168 miles of town roads. Work on the state roads cost $388,420 for plowing ($236.23 per mile), $343,088 for sanding ($208 66 per mile), $17,658 for handling snow fence, and $50,271 for opening waterways. In addition, the shop expenditures totaled $100,952. The average snowfall for the state was 62.7 inches.

The equipment used is as follows:

State-owned

24	3½ ton four-wheel traction trucks, "V" Plows
29	2½ ton four-wheel traction trucks, One-way Plows
82	2-3 ton four-wheel traction trucks, Blade Plows
110	Light trucks 1½ ton, Blade Plows
23	Tractors 5 and 10 ton, "V" Plows
1	Rotary plow 5 ton
269	Total

Hired

356	Heavy trucks
152	Light trucks 1½ ton
2	Tractors
510	Total

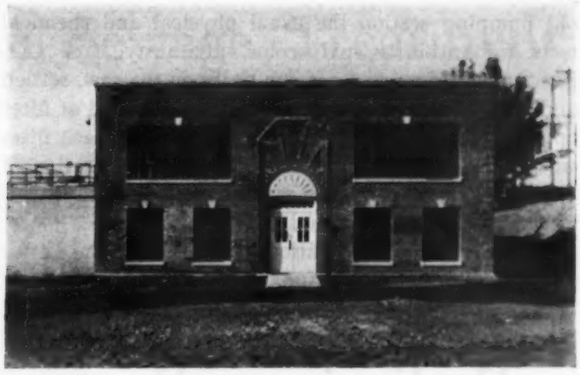
134	State-owned sand spreaders
31	Hired sand spreaders
165	Total

Four-wheel-driven equipment has been found the most suitable. Blade plows of various sizes are used for the general work. These are supplemented with "V" plows mounted on more powerful equipment, such as 3½ to 5-ton four-wheel-driven trucks and 5 and 10-ton tractors. It is probable that some new equipment will be necessary for the coming winter. Just what type, if any, has not yet been determined.

A cleared road in Idaho at 4,000 feet elevation

Madisonville, Kentucky, New Filter Plant

By Hall Arnold
Superintendent of Municipal Light and Water Plant



New building which houses filter plant

MADISONVILLE, Kentucky, organized in 1807, in 1935 has a population of 6,908 within city limits, or approximately 9,500 including the territory adjoining the city on all sides.

In 1913 the city decided to own its own water plant and sold $75,000 of water bonds, with the proceeds of which it built its first reservoir, pumping station, water tower and distribution system. At the close of 1934 it had, from the earnings of the light and water plants, paid off all the bonds outstanding and improved and extended both plants, and had a total investment of $412,159 in the water plant and $139,771 in the electric system, with no outstanding indebtedness and $163,074 in cash.

In 1934 the city decided to filter its supply and plans were prepared by J. S. Watkins, consulting engineer, of Lexington; and on March 20, 1935, a contract was let to the Ruby Lumber Co., a local contractor, for a 1 mgd purification plant, which was put into operation September 19.

This plant was constructed adjacent to the old pumping station, which was modernized and now contains in the basement the steam plant and a Neptune Meter Company's turbine-type totalizing meter, the recorder of which is on the first floor, together with the electric switch board, laboratory, office and toilet room. A tunnel 4 ft. wide connects the two buildings. Trane unit heaters are used for heating both buildings.

The new building housing the filter plant was built of brick, with precast concrete window sills, coping and door trims; floors throughout finished with ¾ in. "colormix" blocked off in 12 in. squares, inside walls finished with buff-colored salt-glazed brick.

The water being treated first enters a mixing chamber 16′ 2″ x 9′ x 12′ into which it flows by gravity from three reservoirs and is pumped from a fourth. In this is an "aeromix" aerator and mixer, into which the alum solution is discharged. From here the water flows over a weir into a coagulation basin having a capacity of 124,000 gallons, affording a detention period of 2 hrs. 23 min. at a 1 mgd. rate. The water level in these is maintained by a Golden-Anderson automatic float valve. The mud valves are "Columbian."

The water then flows to two rapid sand filters, which are separated by a flume which carries settled water to filters and wash water to the sewer. Each bed contains 30 in. of filter sand on 18 in. of 2″ to ¼″ graded gravel. The underdrain system, furnished by the American Cast Iron Pipe Co., comprises 1½″ cement-lined c. i. laterals with brass eyelets in pairs on the underneath side, spaced 2¾″ on radial centers and 12″ on horizontal centers. The effluent passes through "Simplex" rate-of-flow controllers to the clear well, which is located directly beneath the filters. At the juncture of the clear water lines from the two filters, ammonia is applied at a rate of approximately 3 lb. per million gallons and 18 ft. further in the pipe chlorine is applied at the same rate. Just before the water enters the clear well, lime is applied to adjust the pH.

Hall Arnold, superintendent of municipal light and water plant

The alum and lime are applied by means of Wallace & Tiernan type MOF dry-feed machines, located on the main operating floor and connected through the wall into the chemical storage room by extra heavy galvanized pipes so that the chemicals are fed directly into the hoppers of the dry feed machines. The chemicals are stored in the chemical room, to which they are elevated by a hoist. The ammonia and chlorine are applied through Wallace & Tiernan ammoniator and vacuum type chlorinator.

Wash water is supplied to the filters by a Dayton-Dowd pump at the rate of 2800 gpm, which gives a sand expansion of 50%.

In the pipe gallery, which lies immediately beneath the operating floor, are located all the valves used in operating the filters, the rate-of-flow controllers, and low-head raw-water pumps used for pumping water from the one reservoir which is too low to flow to the plant by gravity, and for low levels in the other three reservoirs. All the valves in the plant were furnished by the Rensselaer Valve Co.

There are three high-service pumps—two old De Laval pumps, one of 750 gpm. and the other of 500 gpm. and a new 1000 gpm. Dayton-Dowd pump; all controlled from a central panel on the operating floor or from a control panel in the old building. These pumps are located in a pump pit at the same level as the bottom of the clear well, which is open and is served by a traveling hoist which serves the motors also.

In a large, completely equipped chemical laboratory located in the

old pumping station the usual physical and chemical tests for turbidity, pH, color, alkalinity, free CO_2 residual chlorine, etc., are run daily on the raw, settled and filtered water. The operators keep a record of filter operations on a form which shows the time each filter was in operation, the time it was washed, duration of wash and amount of wash water; the rate of flow, loss of head, length of filter runs and total daily filter hours; the meter readings of filtered water, kwh. used for power; amounts of chlorine, ammonia, alum and lime used; chlorine residual, pH readings, alkalinity, free CO_2, and temperatures of the raw water and of the filtered water in the clear well.

When the plant had been completed it was tested out and a 10-day test run made to the satisfaction of the city by W. H. Lovejoy, superintendent of filtration of the Louisville, Ky., Water Company, who was selected by the city and the contractor for this purpose.

The operation of the plant is under the supervision of the writer, who also has charge of the municipal lighting plant.

Preliminary Survey for Highway Projects

By A. C. White
Highway Engineer, Mower County, Minnesota

I WOULD, as a first step, select a location where there is a relatively large traffic and no probability of immediate improvement and which is close to the location of relief load.

Go through the project doing nothing else at the time but determine drainage areas and sizes of structures in place, and compare these with formula for size of structure and provide for replacing or enlarging them when necessary, determining the fall of terrain and discharge necessary to take care of the rainfall. Locate in note book direction and magnitude of all waterways, and lay out work to follow the natural flow. The necessity of making a visual analysis of soil conditions at all points of the project, I believe, is very well understood. Note the kind of grasses, weeds etc., in order to help on soil analysis. Talk with local people who have lived on the Project and get their ideas of conditions. You don't necessarily have to use their opinions, but many times if the right persons are approached they can give you some suggestions that will help especially relative to drainage and condition of road at all times of the year, where the snow drifts, how the soil acts in the spring, how culverts and other structures act at times of extreme high water, etc.

Look over the potential traffic conditions—who will use the road after built; how far local people will help in furnishing materials and equipment, whether surface will be used for fast and heavy traffic or whether it will be used to haul produce, etc., to market. What you are trying to do is build something that will be of good practical service without undue waste of funds.

Investigate all near-by local building materials and how they can be used. As an example, if stone slabs are available, lay them up for drainage structures. If structures in place are too short, lengthen them with rip-rap, etc. There may be quite a lot of cheap local materials available. Your traffic will determine the width of road bed. I suggest the following:

25 to 75 slow vehicles per day	20 ft. road bed
50 to 100 fast vehicles per day	22 ft. road bed
100 to 150 slow vehicles per day	22 ft. road bed
100 to 150 fast vehicles per day	24 ft. road bed
150 to 300 slow vehicles per day	26 ft. road bed
150 to 300 fast vehicles per day	28 ft. road bed
300 to 600 fast vehicles per day	30-36 ft. road bed

Don't fool yourself on traffic; there are many miles of highways where there are not 25 vehicles per day. These figures are for the potential traffic, but be conservative because you haven't an ocean of money to spend, therefore make every nickel count.

Another item is curvature and superelevation. The minimum curvature should be a 36 degree curve with a 2 foot superelevation, scaled down in the same proportion as the width of roadway, being directly proportioned to a 5 degree curve with a one foot superelevation over the widths stated above.

Your soil analysis, together with your talk with local people on high water marks, will determine the depth of the ditch below the roadbed or the height above the natural ground at runoffs. These two items must work together and the relations suggested are:

Sandy soil	6″ depth
Sandy loam	18″ ″
Loam	30″ ″
Black loam	36″ ″
Clay loam or gumbo	42″ ″

Much can be done in constructing spillways by proper rip-rapping or revetment work on the slope and the application of bituminous materials to safeguard the surface. Mixing bituminous materials with top soil if at all loose will make a mat which will very successfully resist water-action, but, it is absolutely necessary that the slopes be properly rip-rapped.

A three foot ditch, 2 to 1 shoulder slope, 1 to 1 back slope, each side of center line, straight casting work, costs approximately $9.00 per station. End haul can be done by first casting in all the excavated soil, then hauling casting ends with fresnoes while material is loose on surface in casting rows. This class of work is very applicable in gentle rolling country following the contour of the terrain.

I hardly think it advisable to do any expensive or costly grading under the W.P.S.O. set up. Our policy is to do only casting and a small amount of end haul. The grading alone will probably cost $450 to $500 per mile, culverts approximately $250 to $300 per mile, rip-rap about $75 per mile. For this class of work the plans necessary can be very simple by letting the work per station for constructing the standard section.

Plan should show standard section, approximate profile showing center line elevation and stations, approximate grade line only at ends of casting section. A few cross sections at the casting ends to show quantities of haul dirt could be shown, and, this of course re-cross sectioned to show material moved or hauled. Show on plan location of drainage structures, any channel changes, etc. We are adopting the policy of building our heavier-type highways under P.W.A. and the smaller and cheaper highways under the W.P.A. By doing this we can eliminate complete plans for the W.P.A. work.

The Patent Situation in Sewage Treatment*

By Paul Hansen
Greeley and Hansen, Chicago

THIS is written from the point of view of a practicing engineer having no personal interest in any patents relating to sewage treatment but who is called upon by clients to design sewage treatment plants that may embody patented devices and processes. From such a point of view patents may be divided into seven classes:

1. Patents that are valid and useful and for which a reasonable royalty is charged.
2. Patents that are valid and useful but for which an unreasonable royalty is demanded.
3. Patents that are unexpectedly obtained and unexpectedly affirmed by the courts.
4. Patents of doubtful validity but useful for which a small royalty is demanded.
5. Patents of doubtful validity but useful for which a large royalty is demanded.
6. Patents on which royalties are covered in the price of equipment.
7. Patents on which royalties are not covered in the price of equipment.

Valid and Useful Patents with Reasonable Royalties: The first group of patents causes the practicing engineer very little trouble. By "reasonable royalty" is meant one which does not seriously affect the relative economy of a device or process as compared with an alternate possibility of the same or nearly the same suitability. A typical instance of this is the patent on the Imhoff tank. The royalty demanded was reasonable and easily applied. The novelty of the device was such as to raise little question in the minds of most engineers as to the validity of the patent.

Valid and Useful Patents with Unreasonable Royalties: The second group causes little trouble provided it is known in advance of design that the patents are valid as a result of common acceptance of their validity or by affirmation of the courts. There are in most cases enough processes and devices to choose from so that a sewage treatment problem may be reasonably and economically met by using other processes and devices which do not infringe any existing patents or on which royalties are reasonable. This very situation tends to prevent a demand for excessive royalties.

Patents Unexpectedly Obtained and Affirmed by Courts: The third class is the most troublesome, especially when accompanied by demands for unreasonable royalties. Most engineers having to do with sewage disposal are familiar with the unexpected affirmation of certain claims of the septic process patents in the Saratoga Springs case and the subsequent attempts of the owners of these patents to collect unreasonable royalties, principally from small towns. To defend themselves against the claims of the owners of the septic process patents, engineers and municipalities formed an "Association for the Defense of Septic Process Suits." It would have been quite possible to avoid or circumvent the septic process patents. Many well informed engineers were never convinced of the value of the septic tank process and subsequent inquiry, stimulated largely by the experiments at Columbus, O., in 1904, has shown that the septic tank process has such great limitations for large scale use that septic tanks are now obsolete in municipal practice.

A more recent example is the affirmation of the validity of the activated sludge processes by the U. S. District Court of Milwaukee. While the validity of the patents has been in part upheld by the U. S. District Court of Appeals, there has been no accounting nor collection of any royalties. A number of cities which have been sued have settled out of court. Activated sludge is a useful process of increasing economy by reason of refinement and improvements made by engineers generally and it has a wide field of applicability. Most of the early patents have expired or are about to expire in November. Hence the use of the process is not likely in the near future to be restricted by patent royalties.

Patents of Doubtful Validity Involving but Small Royalties: There are some patented processes or devices of doubtful validity. If royalties are small or are unobtrusively covered up in the sales price, engineers are not likely to make much effort to avoid them, especially when the patent rights do not act to seriously restrict competition.

Patents of Doubtful Validity Involving Large Royalties: The fifth class is fortunately not a large class and in most cases the patent claims can be circumvented. Where it is desirable to use a process covered by such patents the engineer should inform his clients as fully as possible regarding the situation and carefully weigh with them the relative merits of paying the royalties asked or challenging the validity of the patents in court. In important cases the cost of litigation may be shared by an association of communities as was done in combatting the septic process suits.

Patent Royalties Covered in Price of Equipment: The sixth group is a large one and may include the other groups, and it is ignored by engineers much more than it should be. The engineer often authorizes payment for these royalties but is not aware of it. He generally does not know what patents are involved nor the amount of the royalties. Such royalties as may be involved are taken care of in the specifications by a requirement that the contractor shall save the client harmless from all claims of patent infringement.

The manufacturer, on the other hand, is much concerned with patents which affect apparatus manufactured by him. If the patents are his own or if he has exclusive control of them, he is apt to feel righteously entitled to the benefits of such patents. If he is constrained to pay to competitors patent royalties on some feature of his manufactured articles he is apt to regard such patents as "nuisance" patents or to use a harsher phrase "stick up" patents. If the royalties demanded are relatively small the manufacturer may find it

* Paper before the American Society of Municipal Engineers.

cheaper to pay them than to challenge the validity of the patents in the courts. If, however, the royalties are relatively large and the validity of the patent is questionable, then it may prove worth while to resort to litigation. But such litigation is very expensive.

In the United States, obtaining a patent is a relatively easy matter. This is due in part to the persistence of an old but now outworn national policy of encouraging invention as a means of building up industry. No doubt this policy did stimulate industry in the early days, but now-a-days it tends to retard industry, primarily because industry must carry a large burden of expense in making numerous patent claims for self-protection and in paying royalties on or combating in the courts many patents that represent nothing fundamentally new by way of invention. Many are mere combinations of processes and devices long known and in use.

Inventors are no doubt entitled to protection in the exploitation of their inventions, but this protection should be administered with due regard to essential justice and to general public interest.

That engineers and their clients may at least know what burden of expense for patent royalties they are called upon to meet, engineers should inform themselves more fully as to the status of patents on which royalties are covered up in the selling price of equipment; and they should also inquire into the methods of exploiting such patents, because there is a possibility that such exploitation may be carried on in such a manner to unduly restrict competition, against their client's interests.

Patent Royalties not Covered in Price of Equipment: Some patents do not relate to equipment used but do relate to processes which are embodied in plans and specifications prepared by the engineer. Manifestly it is improper and unjust to require the general contractor to assume responsibility for such patents, especially if the patents are issued in this country after the works are built or if the patents are of doubtful validity. In case of valid patents it is preferable for the client to make direct settlement of patent claims and to negotiate such settlement prior to the preparation of plans and specifications. In this connection the services of a competent patent attorney are often helpful.

If the exact amount of royalties to be paid is known and fixed, there can be no objection to requiring the contractor to include a designated sum in his bid to cover such royalties, and under some conditions on public works this method may constitute a convenience.

The patent situation in the sewage treatment field does not appear to be serious at this time. Important activated sludge patents have expired or are about to expire. There is now sufficient available choice among sewage treatment processes and devices to permit engineers to avoid or circumvent patents when the demand for royalties is unreasonable; or, as a corolary to this, the existence of such latitude of choice tends to force reasonable royalties for patented processes and devices.

Patents relating to sewage treatment have become more numerous in recent years so that the problem of dealing with patents from the engineer's point of view has become more difficult and complicated. Engineers must devote more attention than was formerly necessary to such patents. However, in complicated situations, especially those involving patents of doubtful validity or excessive royalties, engineers can best serve the interests of their clients by advising the employment of a competent patent attorney.

Beautification Factors in Highway Location and Design

Consideration of the esthetic in highway work prompts investigation and planning during the location and design of highways so as to secure the inclusion of necessary features and items in the preparation of specifications for effecting the conceived and desired result. Such factors include:

1. Locating to preserve natural scenic environment, also to lead to, make accessible, and unfold scenic positions.
2. Establishing general alignment and grade fitting the character of area traversed.
3. Avoiding destruction of valued growth and trees by location and design, and specifying clearing and grubbing provisions for presentable roadside appearance.
4. Reducing to a minimum the unsightly scars in excavation and embankment slopes.
5. Providing permanent roadway locations, widths and slopes, and anticipating future development that there may be the least future disturbance.
6. Studying comparative values and effects on landscaping by featuring bridges, tunnels, walls and cribs in lieu of objectionable cut and fill.
7. Providing additional parking area sites and timber screens for which additional right of way may be required.
8. Removing unsightly obstructions and preventing or controlling encroachments.
9. Rounding excavation slopes to prevent surface slides, to induce small plant growth and to soften lines of construction.
10. Preparing cut and fill slopes with fertile cover soil or by pocketing and benching to encourage natural growth or permit planting.
11. Avoiding scars caused by borrow pits.
12. Locating and designing structures with beauty in mind.
13. Studying drainage provisions to avoid erosion, sumps, collection of debris, etc.

It is obvious that location and design involving the above is vitally concerned with roadside appearance. During construction the necessity for, and responsibility of, giving further study to this phase of road building should not be neglected. Such planning not only contributes to the immediate appearance but provides the preparatory foundation for the final planting or treatment which will complete the work, as slopes become stable and nature helps in plant and tree growth.

This is a statement by Fred J. Grumm, engineer of Surveys and Plans, in the report of the California Division of Highways.

Centrifuging Sludge in Germany

Ter Meer centrifuges are reported to be operating satisfactorily with sewage sludge at Frankfort, Germany (see *Public Works* for December, 1934, page 15). A correspondent to "The Surveyor" (England) for September 20th stated that sludge fed to the centrifuges at 92% water content was reduced to 70%, and was taken by farmers, who pay 30 pfennigs per cubic metre for it. The eliminated water, which contains 10 to 15% of very minute solids, is returned to the sedimentation tanks. Formerly raw sludge was centrifuged, but now it is digested first.

Subdrainage of a Concrete Highway

By Anthony C. Droppers
Highway Commissioner of Sheboygan Co., Wisconsin

View of road, showing location of subdrains.

CONSTANT increase in motor traffic, and in the weights of the units of traffic, over highways is making the problem of the highway departments a serious one. The increase in traffic necessitates not only better and thicker pavement slabs but also stable subgrades upon which to place the pavement. Excess water in the subgrade reduces its bearing power and stability and as a consequence increases the maintenance cost of the highway. For these reasons subdrainage is recognized as an effective and necessary detail of highway design.

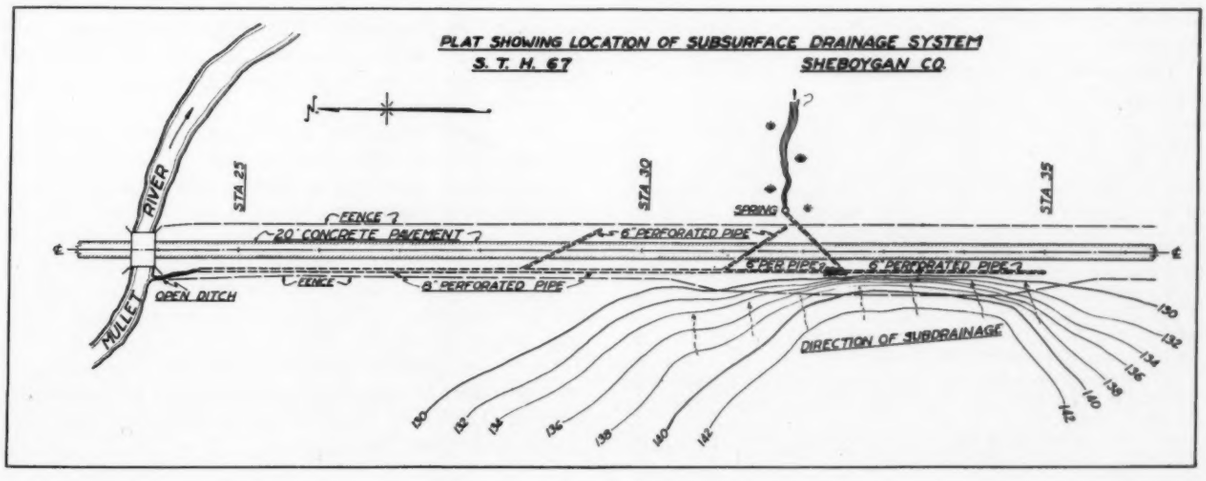
A subdrainage problem of an unusual and unique nature was encountered in the construction of a concrete pavement on ten miles of State Trunk Highway No. 67 in Sheboygan County, Wisconsin, which called for regrading an old gravel road that had been in service for many years, and surfacing it with a concrete pavement.

When the survey was made for the project, special attention was given the detail of subdrainage, with a view to installing it at each point on the project where it was deemed necessary, especially that portion between Station 27 and Station 35 of the project. At this point the highway, which runs north and south, skirted the base of a gravel knoll to the west. Some excavation had previously been made into the knoll for the west ditch of the roadway. The land to the east dropped away from the highway at the rate of about 2% and was slightly swampy. There was a flowing spring, incased in a concrete box, about fifty feet east of the road at Station 32 of the project. A six-inch tile line had at some time in the past been installed below the west ditch line of the roadway and at times discharged relatively small quantities of water. The gravel surface of the roadway over this section had given no unusual amount of trouble, and there was no indication of a soft and highly saturated condition of the soil over which the road passed.

Because of these facts it was believed that a special ditch along the west side of the new grade would provide all the drainage required. The plans called for the new grade line to be an average of 1.5 feet below the old grade, dropping from an elevation of 129.6 at Station 35 to an elevation of 100.5 at Station 28, an average of slightly more than 4%.

During construction, when the power shovel started excavation from Station 35 north, as soon as the gravel surface of the old road, about one foot thick, had been removed it was found that there was under the gravel surfacing an average of four feet of highly saturated black muck on a gravel base. It was decided that it would be necessary to excavate all of the black muck, install an adequate drainage system, and backfill the roadway to the established grade with gravel. A temporary open ditch to partially drain the muck was necessary before the excavation could be completed.

As the underground flow of water into the roadway very apparently came from the gravel knoll at the west, a 6-inch perforated pipe was laid 3½ feet below and along the line of the west ditch, starting from Station 35 and extending north to station 32+50, from which point it was extended diagonally northeast across the



road and discharged into the concrete box of the spring on the adjacent property at Station 32. The construction of the temporary ditch and excavation of the muck had stopped the flow of water into the spring and the property owner had threatened to sue for damages unless he was supplied with at least as great an amount of water as the spring had furnished before the work was started.

The angle in the pipe line at Station 32+50 was covered with very coarse gravel and another 6-inch pipe line was started from this point and extended north along the ditch line to Station 31+00, where it was joined by a 6-inch pipe line which started from the east side of the roadway at Station 31+80. From the junction of these two pipes the water was carried through an 8-inch perforated pipe laid along and under the west ditch line of the road to Station 28+50, where it was joined by another 6-inch diagonal from Station 29+50 on the east side of the road. From this junction the 8-inch pipe was extended along and under the west ditch line of the road to discharge into the Mullet river at Station 24+50.

After the pipe lines had been installed, the road was backfilled to subgrade elevation with gravel, and within twelve hours both of these pipe lines were discharging water, and have continued to do so ever since, in spite of the fact that the years of 1933 and 1934 were abnormally dry. The average discharge of the upper pipe into the spring is 70 gallons per minute, and the discharge of the lower pipe into the river is 100 gallons per minute, a total of 244,800 gallons a day.

It is evident that had not adequate provision been made to dispose of this water properly, the county would have been put to great expense in repairs and replacement of this road. There is no question but that the expenditure of $2,500, approximately the cost of this installation, has been a good investment.

Nation-Wide Abatement of Water Pollution

Recommendations looking to abatement of water pollution on a nation-wide scale, made by the Special Advisory Committee on Pollution of the National Resources Committee, were made public on September 30.

These recommendations were based on conclusions reached after a factual survey of pollution conditions and attempted control in the 48 states, and were aimed to bring domestic and industrial pollution of water under control in the interest of public health, conservation of bird and fish life, and general economic and social progress.

The committee recommended the following policy:

"1. That where drainage area authorities exist for the comprehensive development and control of water, their scope be made sufficiently broad to include control of pollution.

"2. That no basic changes in existing Federal law with reference to water-pollution control be made until the experimental program presented later herein shall have indicated whether or not such changes are desirable and feasible.

"3. That simplification and coordination of State laws be effected to provide for the following minimum requirements:

(a) Adequate administrative control.

(b) Delegation to the administrative agency of power to determine the nature and extent of pollution prohibited by the statutes, and to establish limitations of pollution.

(c) Appropriate mandatory powers, particularly the power to compel the installation of essential remedial works and force other necessary action.

(d) No limitation on the taxing or bonding power of municipalities, when applied to remedial works ordered by the administrative agency.

(e) Power to require facilities through sewerage districts, sanitary districts, or otherwise, that will enable municipalities and industries to comply with the law.

"4. That broader authorization for research be granted to those agencies of the Federal Government which are already concerned with the various phases of the problem, and that adequate funds be provided for properly coordinated water-pollution investigations.

"5. That powers and funds be granted to an appropriate Federal agency to institute a cooperative program of investigation with legally constituted State agencies for such special studies as appear desirable, and particularly for the development of appropriate standards for water use and control.

"6. That in order to stimulate the construction of pollution-abatement works, funds for the purpose be made available by the Federal Government to local public and private agencies on a grant-in-aid or loan basis. Lacking any precedent for the designation of appropriate bases for such allocations, the Committee recommends the creation of a demonstration unit on a river system selected for that purpose.

"Such demonstration unit on an interstate river system of some magnitude, involving several States and the Federal Government, would be best suited for a demonstration of the possibilities of (a) better coordinated water-pollution control legislation in the several States, and between the States and the Federal Government, (b) more adequate administration procedure by State agencies, (c) the development of the legal and administrative procedures for regional or metropolitan pollution abatement authorities, (d) the coordination of municipal sewage disposal projects with statewide or interstate projects, (e) clearing up unsolved problems of treating industrial waste, (f) the extension of cooperation with industry, and (g) the stimulation of public demand for adequate control of water pollution."

The demonstration unit recommended by the Committee would be a Potomac River Conservancy District, to be established to serve as a research unit in a special program of cooperation between the States of West Virginia, Virginia, Maryland, and Pennsylvania and the Federal Government. Such a unit, according to the Committee's report, would not only aid in the solution of many serious pollution problems, but would serve as a training field for the development of scientific and administrative personnel trained for duty with other States.

The members of the committee are Thorndike Saville, Abel Wolman, R. E. Tarbett, well known sanitary engineers; W. B. Bell of the Department of Agriculture; Lt. Col. Glen E. Edgerton, U. S. Engineers; A. C. Fielder, Bureau of Mines, and Elmer Higgins, Bureau of Fisheries; H. R. Crohurst of the Public Health Service working with them on special assignment.

Smoke Survey of New York City

A comprehensive survey of smoke and air pollution in Greater New York has been approved as a project of the WPA, with an appropriation of about $300,000 annually. Approximately 150 engineers, chemists and other scientists will be employed on the work, which will be carried on by the New York Department of Health in cooperation with the WPA.

The aim of the survey is to determine the sources of all air pollution, the damage done to structures and merchandise and effects on health. It is anticipated that the work may require two years to complete. Sol Pincus, deputy health commissioner of New York, has consulted William G. Christy, smoke abatement engineer in charge of the anti-smoke campaign in Hudson County, New Jersey, for advice and help in selecting and training the personnel. Mr. Christy will give a series of lectures to the engineers who will supervise the work and who will also accompany Hudson County smoke inspectors on their daily visits to industrial plants, railroad yards and ocean liners.

Cost and Results of Boulder's Sewage Plant

The sewage treatment plant of Boulder, Colorado, has been in operation since October, 1934, and figures concerning operating costs and results are available. This was one of the first PWA-built plants of this size to be put into operation.

It was designed for a flow of 5.6 mgd. from a population of 16,000; but at the present time approximately 12,000 persons are served, and the sewage flow varies from about 2 mgd. in winter to 5 mgd. in summer. Hourly peak flows in excess of 7 mgd. have been recorded.

The plant comprises: 1—A "Lakeside" Comminutor, capacity 6 mgd. with 3" loss of Head.

2—Primary clarifier, Dorr "Sifeed"; 80' diameter, 11' 4" side water depth; capacity 62,750 cu. ft.; detention period, 2 hrs. at a 5.6 mgd. rate, 1,114 gal. per sq. ft. of tank area per day. The scum is removed by a mechanical skimmer, dewatered and buried. The sludge is pumped periodically to a digestion tank.

3—The sewage is measured by a Cippoletti weir in a measuring box.

4—The digestion tank has a "Downes" floating cover. It is 42 ft. diameter, 23 ft. 4 in. average depth, giving a capacity of a little over 2 cu. ft. per capita. The gas is collected and used for heating the tank by means of hot water from a gas-fired boiler passed through three coils of piping. Heat insulation of the tank consists of tile facing on the walls and air space in the roof. The sludge is drawn off by gravity to drying beds, and the supernatant to the raw sewage conduit; both manually controlled.

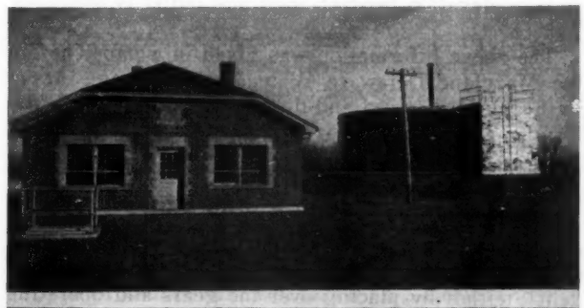
5—The sludge drying bed consists of 24,000 sq. ft. of leveled natural soil, divided into four equal units, giving 1.5 sq. ft. per capita.

6—A machinery house contains four rooms, for chemical feeding, screening, machinery, and laboratory, respectively. There are two "International" No. 8 dry feeding machines with a capacity of 50 to 1,000 lbs. a day, for feeding hydrated lime and ferrous sulphate; the average amounts used (except during July and August, 1935, when no chemicals were used) being 75 lbs. of lime and 140 lbs. of chlorinated copperas per mg. The chlorine is applied by means of a Wallace & Tiernan vacuum-feed chlorinator, 50 to 150 lbs. per day capacity.

7—The sludge is pumped by an Ames plunger pump, capacity 70 gpm. at 30 ft. head, controlled by adjustable time switch.

8—The water is heated in a 6 W 10 "Ideal" gas-fired boiler, with 2,400 sq. ft. A. G. A. hot water rating. The gas from the tank passes through a P. F. T. flame trap on its way to the boiler.

Machinery house and digestion tank



Clarification tank

Cost of Plant

The contract cost of the plant was as follows:

Excavation	$ 7,244.00
Machinery house (superstructure)	7,630.00
Machinery house (substructure)	1,318.40
Screen, installed	2,720.00
Dry feed machines, installed	710.00
Chlorinator	1,800.00
Settling tank, except concrete	3,820.00
Settling tank, equipment	6,370.00
Settling tank, concrete	9,000.00
Digestion tank, except concrete and cover	2,300.00
Digestion tank, concrete	7,084.00
Digestion tank, floating cover	5,480.00
By-pass box	200.00
Diversion box	450.00
Concrete in drying beds and bulkhead	340.00
Pipe lines	6,790.50
Water supply lines	1,320.00
Total contract cost	$64,567.90

The plant was financed by the issuance of general obligation bonds by the city, assisted by a PWA grant of about $22,000.

In addition to the above, since the plant was put into operation a fence has been built and landscaping done at a cost of about $10,000.

Operating Cost

The operating costs since the plant was started in October are:

	Labor	Chemicals	Power	Supplies	Maintenance	Total	Sewage Flow, Million Gallons
Oct.	$45.60	.....	.....	$8.00	.....	$53.60	70
Nov.	312.80	$95.44	.....	95.18	.....	503.42	60
Dec.	309.40	169.36	$28.56	191.07	.....	698.39	62
Jan.	429.20	131.19	29.05	80.54	$24.02	694.00	62
Feb.	121.50	38.90	31.78	17.60	16.98	226.76	56
Mar.	62.50	24.60	28.28	1.05	9.62	126.05	62
Apr.	60.00	89.94	24.52	.....	.....	174.46	60
May	88.50	109.19	30.16	.80	1.50	230.15	85
June	63.50	41.10	30.90	3.04	28.85	167.39	112
Total	$1,493.00*	$699.72	$203.25	$397.28†	$80.97	$2874.22	629

*Includes $872.90 for attendance required for temporary coal-fired boiler previous to start of gas production.
†Includes $192.50 for coal and temporary boiler installation.

As noted above, a total of $1,065.42 is not chargeable to plant operation directly, since the auxiliary boiler was not used after gas production started. The approximate total annual cost of the plant is as follows:

Fixed charges—7½% of $53,000 for 9 months	$2,982.00
Operating cost less auxiliary boiler expense	1,788.80
Total cost	$4,770.80

The total cost per million gallons of sewage treated is $7.58, of which $4.74 represents fixed charges and $2.84 represents operation. The total cost per capita annually is (prorated from the nine months' record) approximately $0.53. Operating expenses are met by a sewer service charge.

Operating Results

Regular tests for plant efficiency have not been kept, but a study covering six days was made in September, 1935, to determine the value of chemical treatment, the results of which are as follows:

WITH CHEMICALS

Suspended Solids, Parts per Million

Day	*Raw Sewage*	*Plant Effluent*	*Percent Reduction*
1st	65	29	54.7
2nd	39	17	56.4
3rd	70	32	54.3
Total	173	78	
Avg.	57.7	26.0	54.9

WITHOUT CHEMICALS

4th	32	13	59.4
5th	83	48	42.2
6th	59	27	54.0
Total	174	88	
Avg.	58	29.3	49.5

During the last three days of this test, approximately 140 lbs. of chlorinated copperas and 75 lbs. of hydrated lime were used per million gallons of sewage. The removal of solids is quite satisfactory; but after all, the condition of Boulder Creek below the plant is the criterion by which the value of chemical treatment can be judged.

The plant was constructed by the Koss Construction Company of Des Moines, Iowa, from plans and specifications prepared by Black and Veatch, consulting engineers, Kansas City, Mo.

Design Features of Depressed Sewers

DEPRESSED sewers (commonly called "inverted siphons") are an undesirable feature of sewerage systems, though sometimes necessary. When used, they should be given the utmost care in designing and construction. A recent illustration evidencing such care forms a part of the Moores Run interceptor in Baltimore, Md. Besides being carefully designed, it is one of the four or five longest in the country.

This siphon carries the sewage from a present population of about 30,000 (estimated to be 70,800 in 1965) across Herring Run valley from east to west between two points 2937 ft. apart, the fall between the two being 11.58 ft. It consists of two parallel lines of pipe, one 18 in. and the other 24 in. Cast iron bell and spigot pipe was used, coated with ⅜ in. of bitumastic enamel. It was estimated that these would carry the 1965 flow, with a velocity of 4.9 ft. per second in the 18 in. pipe and 5.9 feet in the 24 in.; while the minimum flow in 1932, confined to the 18 in. pipe, would have a velocity of 2.1 ft.

Adjacent to the east bank of Herring Run is a blow-off chamber of reinforced concrete 11′ 8″ x 6′ 5″ and 11′ 2″ high, in which is a 12″ tee with gate valve in each pipe line, and 12″ blow-off pipes from these lead to a catch-basin chamber of heavier design, with a brick invert 3 ft. below the inverts of the blow-off pipes, and a 1.5 in. c.i. plate set in the wall opposite these pipes to receive the impact of the sewage. This catch-basin discharges into the stream through a 24″ c.i. pipe provided with a flap valve. The blow-off is for emergency use only.

The inlet chamber is 13′ 4″ x 6′ 5″ of reinforced concrete lined with vitrified brick. This connects the 3′ 6″ gravity sewer to the siphon pipes through two channels separated by a wall of vitrified brick; each channel containing vertical slots to receive two stop boards of 2¾ in. creosoted fir planks, weighted. When it is desired to divert the flow from one of the siphons, for cleaning or repair, the two stop boards are dropped into its slots and the space between them, which is 15 in. wide, is filled with clay.

Just east of the inlet chamber the invert of the sewer is depressed to intercept stones or other heavy objects, the invert sloping sharply to a 5′ x 5′ 11″ chamber placed at one side of the sewer, the floor of which is 2.27 ft. below the invert of the sewer; a 20″ sluice gate being placed in the wall between sewer and chamber to be closed only when cleaning the latter.

The outlet chamber is similar to the inlet chamber.

At intervals of approximately 400 ft. are manholes, a standard class B flanged c.i. tee, pointed vertically, being placed in each line of pipe at the bottom of the manhole. Each tee opening is closed with a c.i. plug of such shape that, when in place, its bottom face forms a continuance of the cylindrical inner surface of the pipe, thus eliminating the possibility of floating matters collecting in the tee. Two plugs cast in the lower face of the plug flange fit into slots in the tee flange to insure that the plug is in the proper position. The plug is lifted, when this is desired, by means of a ¾ in. "I" bolt extending to a slab immediately above the center of the plug.

Joints in the siphon lines were made with mineral lead. Those in wall sleeves at manholes and in pipes in the blow-off chamber were made with lead.

It is planned to use "pills" (wooden balls with diameter 0.8 that of the pipe) for cleaning the siphon. During the more than two years of operation of this ciphon, no maintenance of any character has been required.

At least three other depressed sewers longer than this have been built in this country and Canada. One 6,350 ft. long with a drop of 50 ft. was built by San Bernardino, Calif., in 1929. Three lines, 15″, 18″ and 24″ respectively, are so controlled at the lower end by venturi meters and automatic motor-operated gate valves that the velocity of flow will never be less than 2 ft. per second. When the flow reaches about 3 ft. per sec. in the 15″ pipe, this is closed automatically and the 18″ line opened; when this reaches about 3.2 ft. velocity the 15″ line also goes into service; and when the flow would give 2 ft. velocity in the 24″ line, this is opened and the other two closed.

A depressed sewer 4,820 ft. long with a dip of 135 ft. was built by Toronto, Canada, in 1931 to carry domestic sewage under the Don river. The difference in elevation between inlet and outlet ends is 4.22 ft. The upper end is 8″ c.i. pipe and the remainder of 12″, except for that under the Don river, which is built in two parallel lines, one 6″ and the other 10″. It was proposed to clean the line by flushing if necessary but at latest reports it had not been.

A depressed sewer 2860 ft. long with a dip of 11 ft. was built at Hattiesburg, Miss., in 1917. It consisted of a single line of 8″, vitrified clay pipe being used except for 300 ft. of cast iron under the river. The difference in elevation between inlet and outlet is about one foot.

The above information was given in a paper before the Maryland-Delaware Water and Sewerage Ass'n. by Frank H. Firoved and discussions of same by F. H. Dryden and G. J. Requardt.

Some Water Works Kinks

Large valves located in valve pits are kept in good operating condition in Evansville, Ind., by Superintendent Steithof by placing over the gears and operating mechanism a burlap sack which has been soaked in old waste oil.

Fire hydrants are kept from freezing in St. Thomas, Ont., by placing a bed of manure around the hydrant barrel to a depth of approximately a foot. Superintendent Muller, of that city, is able to operate aerators without freezing throughout the winter by drilling a hole in the bottom side of the aerator, at the end of the main distributor header, which allows for movement of the water so that no dead spots occur.

The Editor's Page

Outlooks in Highway Building

The pendulum of public opinion swings to extremes; the pendulum of engineering opinion probably less extremely, but nevertheless very noticeably. Today, we believe, too much attention is being given to the *extremely* low-cost road, which too often is low only in first cost.

The reason for this, primarily, lies in the policies which governed the CWA, the ERA and, now, the WPA. All labor and no materials result in turning out a very ordinary sort of a road to begin with, and one which in a relatively short time will be little more than a memory.

We believe that developments now in sight will permit a far better design of roads for the purposes for which they are intended. In other words, a better knowledge of highway drainage will permit the use of local materials for substantial bases; and in the rural areas this drainage, with a stabilized or soil-bituminous top, will provide durable, low-cost roads throughout tertiary highway systems. These roads will cost but little initially; they will be built on the stage construction plan, being improved as traffic requires; and they will require a minimum of maintenance.

As these developments enter into the field, we believe that a truer perspective of the place of the higher-type surface will return. Whether this be concrete or bituminous will probably depend on how alive these industries are to the new requirements, and how well they are able to meet the competition.

Stage Construction of Roads

Speaking of stage construction, it should be borne in mind that the basic idea therein is that there should be successive stages, each additional one to be built as soon as the traffic demands it, if not before. There has been evident in some cases too great a tendency to build the low-cost first stage and then forget the others. Succeeding administrations may even fail to learn that the first stage was not considered a finished road.

The result has been that the first stage, while affording a good base, is not able, as a surface, to carry the increasing traffic and goes to pieces, finally reaching the condition where it is no longer suitable even to serve as a base, and the entire investment in the original construction is lost.

Passing the Buck

This procedure has been called an American institution. Samuel Eckels, in his article on another page of this issue, almost accuses some of our technical brethren of this fault, and there is a good deal of truth in what he says. Too many of us are inclined to post the sign "Slippery When Wet" and feel that our whole duty is done.

In the interest of strict justice to the accused, however, we must admit that too often the engineer is not permitted to spend money where his judgment dictates; other sound requirements of administration or government interfere; or, due to diversion of gasoline taxes, there may not be enough money to go around.

But all this merely palliates the offense, and does not excuse it. To an engineer, an obstacle should only be an incitement to find a way over, under, around or through. Safety on existing roads is more important than building more mileage of new ones, especially if the new ones also are to be unsafe. Let's eliminate all these signs.

There Ought to Be a Law About It

To those of our readers who are interested in conserving our streams and our fish and game life, as well as those who are interested in the sanitary engineering aspects of stream pollution, we call attention to an article in the October "Country Gentleman" by J. N. Darling, chief of the U. S. Biological Survey. This article is of interest not only because it follows, in a broad way, the outlines presented in an article in the January, 1935, issue of this magazine, but also because it suggests that industries adding to the pollution of streams be taxed on the basis of costs necessary to correct these stream conditions. There are many practical obstacles in the way of carrying out such a program; but there are also many very practical advantages in it.

As pointed out last January, any regulation, or the imposition of any fee or charge for dumping waste into a watercourse, must be applied on a nationwide basis; probably also on some zoning basis. The funds from such fees or charges should then be applied to the construction of works for improvement of conditions in the area in which such pollution occurs. A sub-committee of the National Resources Committee has already started investigations for improving sanitary conditions on the Potomac River watershed. Anyone offhand can name a large number of other watersheds which are similarly in need of improvement. If funds were available for such work, there need be no great worry about finding places where they can be spent to advantage.

Financial Appreciation of Sewage Treatment

It is not so many years ago that taxpayers and their councilmen begrudged every cent spent for treating sewage, as so much money from which they got no return. Also we can remember when some individual citizens threw their ashes into the alley (unpaved, rutted dirt) rather than pay to have them hauled away. But we have become more civilized—more considerate of our neighbors.

Some cities—a very few—realize enough through the sale of liquid effluent or sludge fertilizer to partially offset the cost of sewage treatment; but several thousand communities operate plants at a net cost of $5 to $15 per million gallons, with comparatively little protest. And why should they object? The cost per family is less than that of a Sunday paper once a week. Nevertheless, engineers should still remember that it is their duty to produce the necessary degree of purification at the minimum net annual cost, and use modern chemical and mechanical aids to that end.

Let's Eliminate:

"This Road Slippery When Wet"

By Samuel Eckels,

Chairman, Allegheny County Authority, Pittsburgh, Pennsylvania; Former Chief Engineer, Pennsylvania Department of Highways

Presented at New Jersey State Safety Conference, Trenton, New Jersey

DRIVING along a modern highway protected by guard rails, curves super-elevated and widened, and sight distances on vertical curves scientifically designed, you are suddenly confronted with this sign—"THIS ROAD SLIPPERY WHEN WET."

This sign—under certain conditions, more terrifying than the red light, the through traffic stop signal, or one way traffic signal—conveys to the driver a feeling of helplessness beyond imagination. It is the bane of the most careful and skillful driver and, regardless of whether or not the pavement is wet, his nerves are on edge.

This sign is a terrific indictment of highway engineers, material manufacturers and safety experts. It is erected only after several accidents have occurred on a stretch of road, and you and I have seen these signs remain in place for a period of years, with nothing done to correct this dangerous condition. The engineer claims that sufficient funds are not available to him to remedy all such conditions, and the manufacturer of road materials, although spending huge sums for experimental purposes, has not developed a "fool-proof," "non-skid" wearing surface.

In 1934, 35,280 direct skidding accidents of this kind are said to have occurred, as the result of which 1,440 persons were killed and 38,160 injured. Compared with totals of 882,000 accidents, 36,000 killed and 954,000 injured, the figures due to skidding seem small and are sometimes referred to as *only* four per cent. If accidents indirectly due to skidding could be included, the figures undoubtedly would be more impressive, but surely the fact that approximately 40,000 persons were killed or injured in a single year should be sufficient to focus attention on this problem of skidding. If more impressive figures are needed, it is necessary only to refer to statistics compiled by states or municipalities having higher average traffic counts than the country as a whole. For example, it has been estimated that 8,377 accidents occurred in 1934 in the State of Ohio alone, 14 per cent of which were attributable to skidding.

A rough surface can be slippery as well as a smooth one

This wholesale killing and maiming of human beings must not continue. Every individual or agency that has any connection, directly or indirectly, with conditions relating to skidding should strive to eliminate this menace. Fortunately, many individuals and organizations are becoming skid-conscious.

Automobile designers and manufacturers, each year, are giving more attention to weight distribution, driving arrangements and methods of braking; all vital factors in skid-prevention. Progressive tire manufacturers are conducting extensive braking experiments to determine what changes in tire design will furnish maximum resistance to skidding.

Technical organizations connected with universities, highway departments, and manufacturing organizations are devising methods for determining coefficients of friction for road surfaces. Such methods will aid in the selection and development of skid-resistant materials and methods of construction.

How to Make Skid-Proof Roads

Highway engineers and highway builders are giving this subject serious attention. They are beginning to design and construct highways that are more skid-resistant than the highways constructed in the past. They realize that high crowns, which contribute so heavily to skidding accidents, are entirely unnecessary, and they now build their highways with just sufficient crown to provide proper drainage. Usually, this does not require more than one-quarter of an inch per foot.

Sharp curves, reverse elevations on curves and improperly banked curves are recognized as potential sources of trouble and are avoided by the careful road builder. Steep grades are giving way to gradual inclines, or signs are posted to warn the motorist.

Manufacturers of road building materials which may produce slippery roads when improperly used are assisting in the instruction of road builders in the proper use of their materials, and those manufacturers who claim to have materials better adapted to the building of skid-resistant roads are featuring this characteristic. Several apparently successful methods of eliminating slipperiness have been developed, among them the results of the efforts of some of the tar distilling companies, which claim that tar road materials are by nature skid-resistant and tend to produce permanently skid-resistant roads. They give many reasons, technical and otherwise, why their materials remain skid-resistant in service. Whether these reasons are correct will be left for the technicians to say. The fact remains

that thousands of miles of slippery road surfaces have been covered with tar to make them skid-resistant and tar has been selected for the building of many new road surfaces for the same reason. Most significant is the fact that seldom does a "SLIPPERY WHEN WET" sign appear on a road surfaced with tar products.

The old fallacy that asphalt and tar cannot be used in the construction of the same road has been exploded. Probably the most significant use of a tar surface treatment on an asphalt pavement is on that section of the old Lincoln Highway between Sewickley and Carnot in Allegheny County, dangerous skidding conditions on which were relieved by tar treatment; and this treatment was also used successfully on the main highway immediately south of Bellefonte and on a long section of the Lackawanna Trail.

No amount of expense required for the redesigning or resurfacing of a road is too great when human lives are in the balance. If the widening of a curve or removal of a crown will effect a remedy, then such changes should be made. If the application of road tar will relieve a slippery condition, then it should be applied. The important thing is that such changes should be made as quickly as possible. Merely to erect a warning sign and then wait until the needed changes can be incorporated in some future program means that a few more injuries or deaths may be added to the already imposing total.

Of course, it is not to be expected that the automobile designers, tire builders, laboratory technicians, materials manufacturers and highway builders can ever eliminate skidding accidents completely. The elements of nature, and more particularly of human nature, over which the engineers and technicians have no control, contribute heavily to skidding accidents. A road surface which is highly skid-resistant when wet with rain may offer little or no skid-resistance when covered with ice, snow, mud or wet leaves from trees. Surfaces carefully designed and constructed, which should be adequately skid-resistant, even when wet, for normal automobile traffic, may not be sufficiently skid-resistant to protect a careless or intoxicated driver against skidding.

To counteract these elements of nature and human nature, every agency for the dissemination of information about skidding must be employed. As stated previously, many of those responsible for the building and maintenance of roads have become skid conscious. Everyone connected with the operation of each automobile (and even the pedestrian who, by careless jaywalking, can cause the sudden application of brakes and a disastrous skid) must join forces to prevent skidding accidents and thus prevent the destruction of property and human lives.

The time has come for every motorist, material producer, material manufacturer, automobile designer, tire builder and motor club to get behind some slogan resulting in action leading to the elimination of slippery pavements; and let us not overlook recklessness. Policing of highways, streets and boulevards should be carried on relentlessly. Recklessness in driving is recognized as a crime. Safety engineers in particular should be behind this movement.

Let us eliminate this sign "THIS ROAD SLIPPERY WHEN WET."

Double hazards—slipperiness added to R. R. crossing and curve.

Run-Off Records From D. of A. Demonstration Projects

Demonstration projects of the Department of Agriculture report some run-off figures which are of interest. On these projects, terracing, strip cropping, contour farming, log and masonry dams in gullies and land in grass and timber are used.

Floods in the Muskingum valley project area in Ohio, the second week in August gave erosion control measures a severe, but practical, test. Good grass sod especially proved its worth in soil and water conservation.

Only 61 per cent of the rain falling upon a grass experimental plot was lost. A plot in continuous corn lost 82 per cent, but a corn plot with crop rotation was more efficient, losing only 75 per cent. Wheat stubble retarded water run-off in another plot, which lost only 65 per cent. A plot with practically all the vegetation removed lost 96 per cent of the water falling upon it. Water that rushed off the cultivated plots was muddy, carrying soil with it; that off the grass plots was clear, showing that grass land holds erosion to a minimum, even under heavy rains.

A woods plot on the soil erosion experimental farm near Zanesville, Ohio, has had little water loss and no soil loss since its establishment in October, 1933. Less than one-half inch of approximately 50 inches of rainfall on this plot has been lost by run-off, a contrast to the average annual water loss of 25 per cent from experimental plots planted to corn.

At the soil erosion experiment station at Temple, Tex., land in corn with rows up and down a 4 per cent slope, lost between 5 and 10 tons of dry soil an acre during a rain of 4 inches per hour. The run-off ranged from 43 to 50 per cent. Land in oats on a 4 per cent slope lost less than 0.2 of a ton of dry soil per acre. The run-off from the oats was as low as .4 per cent and not more than 3.34 per cent.

Land with a Bermuda grass cover on a 4 per cent slope lost only .02 of a ton of dry soil per acre. The run-off was 1.33 per cent.

These are examples of hundreds of cases where erosion control methods proved their worth by actual measurements. "Their application is so simple and yet so logical," says H. H. Bennett, Chief of the Soil Conservation Service, "that they do not need to be sold to an open-minded farmer whose rolling acres are losing topsoil at the rate of many tons a year. With him, seeing is believing."

Chemical-Mechanical Treatment of Sewage

By Philip B. Streander* and Michael J. Blew†

V—*Sludge Treatment. Factors Governing Choice of Method—Results Obtainable*

Dewatering on Sludge Drying Beds One method of dewatering sludge is by placing it on ordinary underdrained sludge drying beds. In those parts of the country where the climate is warm these beds can be uncovered, but where it is cold and subject to freezing weather the beds should be glass covered. Potter and Killam ran a series of extensive experiments at the Atlanta experimental treatment plant on the dewatering of chemical sludge on open sludge drying beds and found that the sludge drained rapidly. In 14 days the average sludge concentration was increased from 5 per cent to 50 per cent and in 30 days it was increased to 80 per cent. The sludge dried with the characteristic cracking and spalling, was spadeable within 10 days, relatively dry in 14 days and had dried to a hard compact cake within 30 days and assumed a fibrous powder form. During this test the average mean temperature was 71°, the average humidity was 68 per cent and the average monthly rainfall was 3.15 inches. This same method of sludge drying was practiced to some extent in the old order of chemical treatment, but the sludge was not conditioned prior to its application to the beds, and more often than not it was septic before it was placed on the beds. With comparatively fresh sludge, conditioned to improve its drainability, drying on underdrained sand beds is an efficient and inexpensive method of dewatering chemical sludge, particularly for the smaller plants. The dewatered sludge contains a sufficient amount of ferric hydroxide and calcium oxide to materially delay putrefactive action and when reduced to between 30 and 40 per cent concentration repeated wetting by rain has no apparent effect on the sludge.

Vacuum Filter Dewatering In larger plants and in plants where sludge drying beds would have a deleterious effect on the appearance of the plant, chemical sludge can be dewatered by means of vacuum filters. With these the sludge is pumped out of the settling tank, with a minimum disturbance and agitation of the sludge, and discharged into sludge conditioning tanks where chemicals are added, usually ferric chloride, for supplementary coagulation. From here it is piped to the vacuum filters, the dewatered cake being transported by belt or screw conveyors to its ultimate point of disposal and the filtrate returned to and mixed with the raw sewage for subsequent treatment. The capacity of vacuum filters is usually rated in pounds of solids (dry basis) per hour per square foot of filter area. This capacity is influenced somewhat by the characteristics of the raw sludge, but depends largely on the effectiveness of the conditioning of the sludge by means of added coagulants to improve its drainability. In actual installations of vacuum filters, dewatering chemical sludge, capacities as high as 12 to 14 pounds of solids (dry basis) per hour have been secured per square foot of filter area. In experimental work, capacities of 3 to 4 pounds were obtained using unconditioned sludge. For average sewages and conditioning of the sludge prior to dewatering it is probably safe to base the filter area on an average loading of 10 pounds (dry basis) of sewage solids per hour per square foot of filter area and determine the total area by the amount to be dewatered during a predetermined number of hours per day of filter operation.

Centrifuge Dewatering The dewatering of chemical sludge in centrifuges has not been practiced in this country. At the present time experimental work is being conducted on two full size centrifuges. One of these is located at the Collingswood, New Jersey, activated sludge treatment plant and has been operated daily for almost a year on raw sludge, digested sludge and combinations of these with activated sludge. This machine is of the vertical batch type with automatic control of loading and unloading. The other machine is located at the Philadelphia Northeast sewage treatment plant and has been operating on raw and digested sludge. This machine is of the vertical continuous loading and unloading type. Centrifuges have been in successful operation for several years in the dewatering of sludge at Frankfort (Germany) plant. These machines are of the horizontal batch type with automatic loading and unloading of the sludge. They operate at the same speed during both loading and unloading. Centrifuging of chemical sludge should be quite practical as the filtrate from the machine will be relatively low in suspended solids and the characteristics of the sludge are such that accelerated gravitational separation should result in the rapid segregation of the solids from the liquid. This method of sludge separation is not only feasible, but may be preferable in many instances to vacuum filter dewatering. However at the present time there are not sufficient data available on which to base any conclusions covering their use.

Chemical Sludge Digestion Chemical sludge, that is one produced by a ferric or ferrous salt with the addition of lime, is not particularly amenable to digestion on account of its high lime content and hydrogen-ion concentration (pH). While the pH could be reduced to the point under which digestion usually proceeds, the lime itself cannot be removed. Digestion is retarded, foul odors are produced and molds and fungi develop rather than bacteria. Some laboratory experiments were conducted by the authors on the digestion of a lime-iron sludge. These experiments were not carrid out on an elaborate scale, but from observations and tests made, digestion of this kind of sludge is not an effective nor an efficient method of sludge treatment. On the other hand, sludge produced by a ferric salt or chlorinated copperas, without lime, can be digested. Rather extensive experiments have been conducted by Rudolfs in which it was shown that the iron slightly retarded the digestion at the beginning but once having started, digestion then proceeded satisfactorily. This method of sludge treatment is now in use at the Birmingham, Alabama, plant. By proper balancing of the quantity of sludge added per day and with suitable control and operation, digestion once set up proceeded normally to its conclusion. Therefore digestion, as a method of converting the unstable organic matter to inorganic ash, can be used with an

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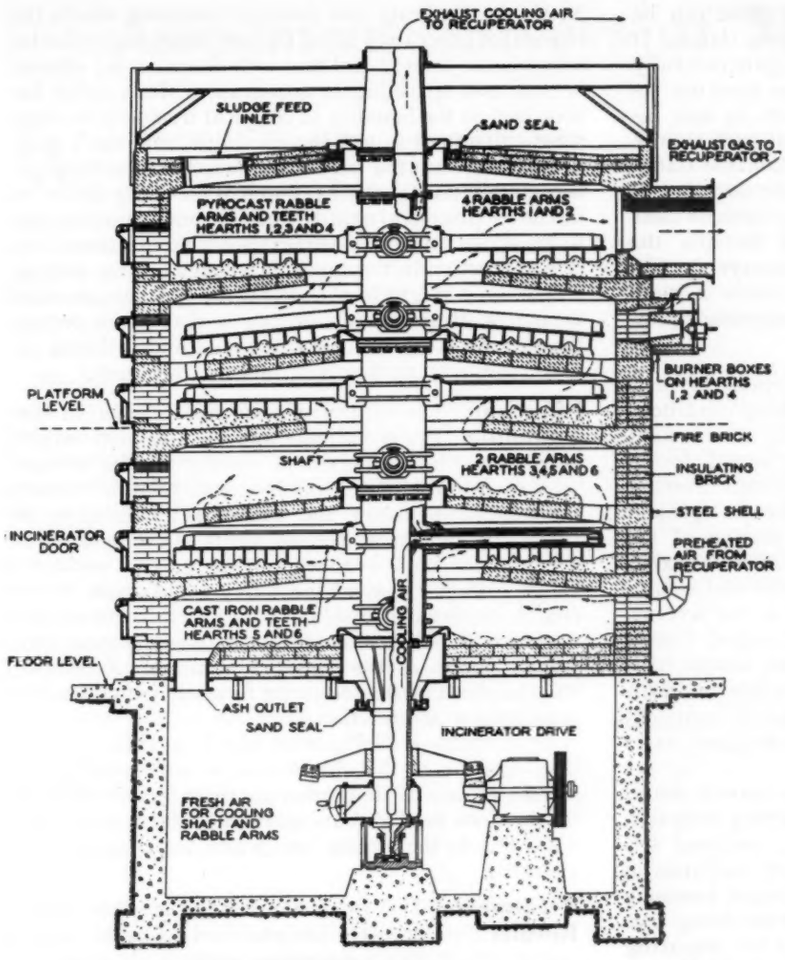
EXHAUST COOLING AIR TO RECUPERATOR
SLUDGE FEED INLET
SAND SEAL
EXHAUST GAS TO RECUPERATOR
PYROCAST RABBLE ARMS AND TEETH HEARTHS 1,2,3 AND 4
4 RABBLE ARMS HEARTHS 1 AND 2
BURNER BOXES ON HEARTHS 1,2 AND 4
PLATFORM LEVEL
FIRE BRICK
SHAFT
2 RABBLE ARMS HEARTHS 3,4,5 AND 6
INSULATING BRICK
STEEL SHELL
INCINERATOR DOOR
PREHEATED AIR FROM RECUPERATOR
CAST IRON RABBLE ARMS AND TEETH HEARTHS 5 AND 6
COOLING AIR
FLOOR LEVEL
ASH OUTLET
SAND SEAL
INCINERATOR DRIVE
FRESH AIR FOR COOLING SHAFT AND RABBLE ARMS

Fig. 10. Nichols-Herreshoff sludge incinerator operating at the Dearborn West Side sewage treatment plant.

iron sludge under conditions similar to ordinary digestion of raw sludge, but the use of such a method is questionable with an iron-lime sludge.

Ultimate Disposal Dewatering of a chemical sludge to its water-bearing power by drying, or treatment by digestion, is only one step in the process. There still remains its ultimate disposal. For small plants and those so located that the sludge can be used as a soil conditioner or fertilizer aid, the sludge can be disposed of to farmers, gardeners, etc. However, such a method of disposal is not always satisfactory as it entails storage of the sludge until it is hauled away in the spring or fall of the year. The demand is not constant, and quite often educational promotion work must be carried on by the municipal officials to create a continuous demand for the sludge. For large plants such a method of disposal is not a satisfactory one and therefore other methods must be used.

Incineration of Sludge Incineration of sludge has always been considered as an ideal solution of the sludge disposal problem, particularly for the larger cities, but the difficulty has been in the finding of suitable equipment in which the sludge can be burned economically. Various attempts have been made in the past to incinerate sludge on fixed drying and burning hearth or grates with questionable results. Sludge with its high moisture content and its comparatively low heat value is not an easy material to burn, as has often been demonstrated. By increasing the solids concentration to between 30 and 40 per cent, sufficient liquid or moisture has been expelled to secure a self-combustible or burning sludge, but proper conditions in drying and burning must be maintained. The anticipated success of the incineration of sewage sludge lies in the fact that engineers have finally recognized the effectiveness of separate drying and evaporation of the sewage liquid prior to its burning. At the Dearborn, Michigan, chemical treatment plant there has been recently installed an incinerating plant to burn all of the sludge. This incinerator, a sectional view of which is shown in Figure No. 10, is of the vertical multi-tray continuously raked type in which the upper trays serve to evaporate the liquid, the central trays are those on which combustion takes place and clinkering occurs on the lower trays. The action of the incinerator is practically automatic and all raking, stoking, etc., is done by means of mechanically operated scraper arms over each tray. Other types of incinerators are also now available designed on the basis of separate drying and evaporation of the sludge prior to its burning. These other types make use of rotary drying drums or kilns of various designs and combined with the burning grates in differing methods. Burning grates can also be provided with power operated feeders, stokers and clinkering mechanism.

Factors Governing Choice of Method

Promotion of Processes From the inception of the new forms of chemical treatment, promoters of these processes have made such extravagant claims covering the merits of their particular process and have used such methods of promotion that they have created doubt and a certain antagonism in the minds of experienced sanitary engineers. At the same time this commercial exploitation of chemical treatment has undoubtedly been largely instrumental in forcing the attention of engineers to this method of treatment and without it chemical treatment would not be receiving the attention it now is.

Choice of Method The promotion of chemical treatment processes by various promoters has naturally resulted in having each individual process referred to by name rather than as a method of sewage treatment. It is foolhardy for any promoter of a process to make indiscriminate claims as to the degree of purification which can be effected by his process without first having carefully studied all factors involved. No censure is directed against such promotion if confined to locations where its application is merited and careful study warrants its adoption.

Patent Situation At the present there have been issued a number of patents covering various processes and combinations of treatment. A literal translation of the claims granted is such that it

is doubtful if any chemical treatment plant can be designed without infringing one or more claims. It therefore behooves the engineer to investigate carefully the patent situation, and unless he adopts some one so-called process he should ascertain wherein he may infringe and then take steps to circumvent such claims. While most process patents have a questionable standing in a field as old as chemical treatment they can be extremely embarrassing at times and may in some cases serve to restrict competition, in which instance the project can be indefinitely delayed by taxpayers' suits. Equipment patents on the other hand have a more secure position as in most applications competing equipment is available.

Design Procedure Having determined that a chemical treatment best meets the obtaining conditions of plant location, seasonal or constant dilution ratios, etc., the next step is the actual design of the plant. There being no valid basic patents covering chemical treatment of sewage, its use does not present grounds for litigation and the major portion of the plant can readily be designed so as to circumvent existing patents covering proprietary processes and combinations thereof. This covers such parts as bar screens, grit chambers, settling tanks (without integral filter), chemical storage and feeding equipment, sludge handling and dewatering, incineration if required and filtration (separate beds) if a high degree of treatment is required. All of these should be so designed as to allow competitive bidding.

Among the features which may involve patent claims are certain combination methods of applying coagulating chemicals, methods of flocculation, combined settling and filtration tanks, the use of inert materials in a certain order and the removal of nitrogen ammonia from the sewage. The parts of the plant involving patented methods can be readily covered by preparing plans for each method and with alternate bid items for each. The same procedure can be followed for the coagulating methods and flocculation devices. Where filtration of the effluent is to be included as a part of the treatment plant, plans can be prepared covering the unit combined with the settling tank or as separate filter bed units. Alternate bid items can be provided so that bids may be taken on two or more methods or equipment.

While such a procedure requires considerably more work in the preparation of the contract plans and specifications, it will tend to largely eliminate any claims covering restriction of competition and may in the end be less expensive than specifying and showing one type of equipment or any one process. After bids are received it is comparatively easy to evaluate the bids on each process or items of equipment by adding to the cost of the competing items of equipment such construction as is required for its installation and operation. After such additions are made they serve to become the basis of award to the lowest responsible bidder. The consulting or designing engineer should be thoroughly familiar with all new developments not only in chemical treatment as a whole, but in the application of the special equipment required in the plant. In the final analysis, the engineer in charge of the work is the arbiter and the success of any project depends largely on his ability and good judgment in the handling of project.

Results Obtainable

Degree of Treatment Possible Treatment results as instanced by plant operation at Dearborn, Mich., and Birmingham, Ala., and by experimental plant operation at Atlanta, Ga., Chicago, Ill., Philadelphia, Pa., Palo Alto, Calif., New York, N. Y., etc., indicate that chemical treatment effects the removal of practically all of the suspended and colloidal solids in the sewage and that with filtration the effluent is clear and sparkling in appearance. Much stress has been laid on the inability of chemical treatment to effect a reduction in dissolved organic solids, but from a practical standpoint the only difference between chemical flocculation and biological flocculation is the ability of the latter process to oxidize unstable ammonia nitrogen to the stable nitrates. Chemical flocculation causes little or no reduction in the ammonia nitrogen in the sewage. Therefore it might be stated that the optimum chemical treatment of sewage obtainable is that which secures the maximum removal of suspended and colloidal organic solids up to dissolved ammonia nitrogen.

Effect on Ammonia Nitrogen The quality of ammonia nitrogen in sewage is variable and is influenced largely by the age and density of the sewage. While there is no actual relation between the oxidizable matter and ammonia nitrogen, or between this and the suspended solids in the sewage, the average ammonia nitrogen content of raw sewage is roughly 15 per cent of the 5-day B.O.D. and 10 per cent of the suspended solids. It is generally known that the presence of ammonia and nitrogenous organic compounds increases the bactericidal action of chlorine. This has been attributed to the formation of chloramine according to the reaction—

$$Cl_2 + N H_3 = N H_2Cl + HCl$$

The chlorine in the chloramine is an oxidizing and sterilizing agent and when in the alkaline state the chloramines produced are powerful retarders of action (B.O.D.) in the stream into which the effluent is discharged.

Treatment Results The treatment results possible with a properly designed and operated chemical treatment plant, without filtration, will effect a reduction of between 75 and 85 per cent of the biochemical oxygen demand; and with filtration will effect a practically complete removal of the suspended solids in the sewage. With chlorination, the nitrogenous compounds are reduced to chloro-substitution compounds which are more or less useless as bacterial foods and are therefore less putrescible.

Power Plant Installed From Water Profits

Instances are numerous (we have described a number of them) where municipal light and power plants have furnished, from their profits, funds for buying, installing or extending water works plants; but Gainesville, Tex., furnishes news by reversing the procedure and installing a power plant from the profits of its water plant.

Originally the water was lifted from well to standpipe by steam engines, using gas under the boilers. Cost, $30 per million gallons.

Then oil became cheap and was used under the boilers. Cost, $20 per million gallons.

In January of this year a Diesel engine was installed. Present cost $6.00 per million gallons.

The diesel (a Type J T Cooper-Bessemer, 365 hp. at 327 rpm) drives direct an electric generator (312 KVA, 2400 volt, 3 phase, 60 cycle) which, besides pumping the supply, furnishes current for the White Way, City Hall, Fire Department, parks, and some street lights.

Money for buying this diesel was obtained from the surplus revenue of the water plant. With still more profit obtained with the more economical plant the city hopes to be able soon to buy a 750 hp. diesel and have a real municipal power plant.

Assessment Surveys of Municipalities

WAYNE COUNTY, Mich., is preparing maps for assessment use of all lands within Wayne County not within incorporated city limits, and also proper and legal descriptions of each parcel of land on the various township tax rolls. The maps are made up into sets and bound, one set to each township. For the ordinary township there would be 144 plates, each plate showing a quarter-section at a scale of 200 feet to the inch.

The base for each of these plates is a closed traverse field survey around each square-mile section, and the location of the center-post of the section. Additional field work is done on irregular sections, angling roads and on areas where a number of small parcels warrant the recording of an assessor's plat.

The parcels of land comprising a quarter-section are assembled from a number of sources of information. Deeds, mortgages, plats of record, probate and law files are used for information, together with all known land surveys that are available. All records such as vacations, road widenings are also shown.

After the plats have been finished, descriptions are written and placed on a card. These cards are keyed to the plates by letters and have other information pertinent to assessing.

In the future, each year's roll will be compiled from these cards. In the past, the descriptions were copied from one year's books to the next, thus perpetuating errors.

The value of the work being done, aside from the past blind method of assessing without any kind of maps, will be apparent in the elimination of loss of tax-money from erroneous descriptions which are assessed at large.

Assessment surveys of cities and townships as well as counties are desirable (where they have not already been made and kept up to date) in order that untaxed real estate may be discovered and entered on the tax rolls, and errors in land records be discovered and the exact frontage of each lot known, to be used as a basis for correct billing of improvements and other charges based on frontage. Also the surveys may furnish the information for preparing a master map for the use of all the municipal departments in their various activities. Communities that have undertaken such work have found it revenue producing to an unusual degree, the cost of the entire work sometimes being covered by the added taxes collected the first year following.

A present advantage is the work furnished for unemployed civil engineers and other "white collar men," very little equipment or material being needed. Baltimore, Md., has been at work on such a survey since 1926, but with so small a force that it was estimated in 1933 that 75 years would be needed to complete it. CWA men were obtained and in the spring of 1934 there were 293 men employed on the project, of which 25 were obtaining correct descriptions of property and present property owners in the Record Office; 150, working in groups of 3, were measuring, locating and sketching properties in the field with tape and transit; 30 draftsmen were plotting the filled data and, after completing finished tracings, were superimposing the title information upon them, thereby developing very complete and accurate tax plats on a scale of 40 ft. to the inch; also 30 men were coordinating the records of the Appeal Tax Court with those of the Property Location Division; 50 were transferring certain data from the Tax Plats to the Tax Ledgers; and 8 were employed on personnel organization or other special work. Among the incidental benefits of this work, insufficient flat-rate water rents were discovered and other inadequacies which, when corrected, are expected to add $100,000 to the city's annual revenue.

The above is drawn from a report of the Committee on Municipal Field Engineering of the American Society of Municipal Engineers, Walter Starkweather, chairman, and a discussion of same by Bernard L. Crozier and Edward J. Hecker, chief engineer and engineer of plans and surveys, respectively, of the Dept. of Public Works of Baltimore. As a part of the report, Mr. Starkweather makes the following suggestions for making assessment surveys:

Surveys

1. ORGANIZATON.—Field parties for assessment surveys should have from three to five men, depending upon local conditions. A field party of five would contain a chief of party, an instrumentman, a recorder and two chainmen.

2. EQUIPMENT.—An ordinary engineer's transit, 50-foot and 100-foot steel tapes graduated to feet and hundredths, sighting poles, survey notebooks, etc., are all that is necessary for each field party. In most cases auto transportation will have to be arranged.

3. LIMITS OF PRECISION.—Good judgment must be used in arriving at the best limits of precision to be used in the measurement of angles and distances, depending on the type of property and its comparative value, varying from valuable city frontage to unimproved acreage.

4. PLAN.—The plan of procedure should follow the idea of making a complete survey of a given area selected in advance, each field party being assigned a certain part of this area and tying-in their surveys to any existing local control points and to each other.

Office Work

1. DRAFTSMAN AND SEARCHER.—An office man working for each field party as a draftsman and searcher of records should do the preliminary reference work for the survey as it progresses and make standard maps of the area from the survey.

2. EXISTING MAPS.—All existing maps of surveys and layouts of subdivisions or construction work in the area should be located and the data on them made available to the field party in convenient form.

3. DEEDS.—Deed descriptions of all property involved should be looked up and abstracted for the field party.

4. NEW MAPS.—Maps should be drawn from the field survey notes to a convenient size and useful scale. One map size and one scale should be chosen for the whole project, consideration being given to convenience in handling a number of maps bound together for the use of the board of assessors. For city or village areas the scales 1 inch equals 100 feet or 1 inch equals 300 feet are recommended.* Areas should be calculated and recorded and assessors' valuations noted in pencil on completed prints.

5. ASSESSORS' RECORDS.—A careful check should be made of the assessors' records of the properties in question and any discrepancies with the deed descriptions noted.

6. COSTS.—The calculation of the cost of the project should be kept in the form of a progress report.

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*Commenting on this, Crozier and Hecker say: "We feel that the scale 1" equals 100' would produce a map, in the case of most cities, too small for universal use. In the city of Baltimore, our standard scale for all purposes, except maps of the entire city and atlases, is 1" equals 40'. Much progress has recently been made in methods and manners of duplicating and it is relatively a simple matter to convert a master map, drawn to the scale of 1" equals 40', into any other scale by means of any one of numerous methods of duplication. These methods are also very flexible in that any data on the original master map not being desired on the new scale may be very easily left off and on the contrary anything not on the original map can be very easily added to the new map."

7. GAIN.—Estimates should be made of the net gain in taxes per year or the saving made for the community.

Resulting Records

1. ASSESSMENT RECORD CARDS.—An assessment record card for each lot or piece of acreage should be made out. In the case of these cards for Wayne County, Michigan, the original cards are taken to the sites and filled out and copies are typed for the office file, the County tract index department file and the Township Supervisor's file.

2. MAPS.—Accurate maps with measurements and areas recorded on them are added to the public records and become a permanent asset to the community.

Permanent Chlorine Standards

Major Francis E. Daniels, Sn-Res.,
Pennsylvania Department of Health

EVER since the first use of ortho-tolidin, in 1907, for the determination of minute quantities of available chlorine, permanent standards have been employed for comparison. In 1907 the writer used solutions of potassium dichromate made up to match the colors of ortho-tolidin and chlorine in 50 ml. nessler tubes. Then Ellms and Hauser improved the shade of color by adding copper sulphate. These standards are still published in the Standard Methods for the Analysis of Water and Sewage, using 100 ml. tubes of 300 mm. depth.

Later Muer and Hale published another set of standards using tubes of 240 mm. depth.

All these standards are too dense in the higher numbers to be matched and read when viewed down through and are inaccurate when viewed sidewise. They are too bulky and cumbersome for ready transportation and field work.

This led to the adoption of a great variety of smaller and more portable sets of standards or comparators, some using colored glass discs of graded shades, others using tubes, ampules, or bottles containing colored solutions of unknown composition.

In the new comparators the depths of the solutions vary greatly, but in general, range from about one half inch to two inches.

About a year ago the New York Department of Health published figures for making standards from solutions of potassium dichromate and copper sulphate to be used in small commercial square bottles. This is a great convenience to many operators. It enables one to make a satisfactory comparator with little trouble and avoids the expense and delay in the purchase of one of the commercial sets.

In designing a new chlorine testing set for field work for the United States Army (see PUBLIC WORKS, January 1935) the writer needed the proper shades of color for one inch depth. For some unexplained reason, we in the Pennsylvania Department of Health Laboratory were unable to make the New York solutions match under our conditions, as they appeared to us to be too green. Rather than introduce new complications, we decided to adhere to the solutions as given in Standard Methods; but on account of the depth of color necessary in the higher quantities we doubled the strengths. The composition of each solution and amount used are given in the table.

We were fortunate in having the use of a Klett precision colorimeter with which to make accurate comparisons at thirteen, twenty-six and fifty-one millimeters depths or approximately one-half, one and two inches respectively.

As we were not entirely sure of our chlorine-demand-free dilution water, we were not surprised to find some difficulty in getting check results.

To take advantage of any possible time factor in the reaction between chlorine and organic matter, we decided to add the ortho-tolidin for each test to the dilution water before putting in the measured amount of a carefully titrated chlorine solution to give the strength desired. In this way we got checks every time with surprising accuracy.

The accompanying table giving our results is published for the use, check and criticism of other workers. By plotting the figures on cross section paper, curves are obtained from which interpolations for other values or depths may be obtained.

Solutions

1. *Potassium Dichromate.*—Dissolve .5 gm. $K_2Cr_2O_7$ in a little water. Add 1.0 ml. H_2SO_4 and dilute to 1 liter.
2. *Copper Sulphate.*—Dissolve 1.5 gms. $CuSO_4 .5H_2O$ in a little water. Add 1 ml. H_2SO_4 and dilute to 100 ml.

PREPARATION OF STANDARDS

CHLORINE	COPPER SULPHATE SOLUTION	POTASSIUM DICHROMATE SOLUTION		
		13 mm. depth	25 mm. depth	51 mm. depth
p.p.m.	ml.	ml.	ml.	ml.
.1	1.8	8.0	7.5	7.0
.2	1.9	16.5	15.0	14.0
.3	1.9	24.5	22.5	20.0
.4	2.0	32.5	30.0	25.5
.5	2.0	40.5	37.0	31.0
.6	2.0	47.5	43.5	36.0
.7	2.0	54.0	49.0	41.0
.8	2.0	60.0	54.0	45.5
.9	2.0	65.5	59.0	49.5
1.0	2.0	71.0	64.0	53.5

After mixing the copper sulphate and potassium dichromate solutions, dilute with distilled water to 100 ml.

Sanitary Survey of Reservoir Watersheds

Beginning in March of last year as a CWA project and continuing since April as an ERA project, a sanitary survey has been made of the watersheds draining to two of the reservoirs of the Cambridge, Mass., water supply. The Federal government provided salaries for three sanitary engineers who worked three days a week and the water department provided transportation. The object of the survey was to learn where water was being polluted or was likely to be, make recommendations for rectifying objectionable conditions, and obtain data for bringing up to date the map showing streets, buildings, streams, swamps, etc.

The data obtained included, for each house on the watershed, the names of owner and tenant, number of occupants; method and condition of sewage disposal; special hazards such as manure piles, dairy wastes, piggery drainage, slaughter house wastes, etc.; all of which are recorded on 3x5 cards and filed. Special attention was paid to a piggery in Waltham, adjoining a watershed, were submitted to the Director.

For recording the survey data, eight maps 34x26 inches, scale 400 ft. to the inch, with an index map, are being made. These show all reservoirs, ponds, brooks, swamps, railroads, streets, lanes, the outside watershed line, and all important buildings on the watershed.

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Opening streets to reach leaking water pipes; ripping out old pavement to make way for new—this necessary preliminary work adds to the cost of the actual job. The following report shows how Barco Portable Gasoline Hammers reduce this expense:

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Road Improvement Surveys and Estimates

By S. M. Rudder

Engineer of Surveys & Plans, Missouri State Highway Department

THE Missouri State Highway Department, in using Federal funds for highway improvement, found it necessary in only one or two projects to begin construction before completing the plans (as was permitted under FERA), and even in these cases information was available from which the design of the proposed roadway could be determined. In these projects, construction began as soon as the center line had been projected and right-of-way secured. The necessary data were gathered during construction, and by the time this was completed the detail plans showing the improvement were finished. We do not make it a practice to build roads with only meagre plans, but this work was handled by a competent engineer, who carried out most economically the design as originally conceived.

Our regular procedure in adding roads to our state highway system is as follows:

As soon as it is considered desirable to extend a highway into a rural community, we immediately cause a thorough investigation to be made. A special engineer is assigned the task of making a study of the territory. He submits a reconnaissance report, a sample copy of which is attached. With this information, the location can be properly established and a final study made to determine the standard and type of road needed to meet the requirements of both present and potential traffic. The possibility of future development, along with present conditions should govern the particular features of design.

As you will note in this sample reconnaissance report, an estimate of cost of the road is given. The engineer doing this kind of work is a high-class man, well versed in highway design, location and construction. To us it is important that the reconnaissance provide accurate and reliable information.

After the location has been adopted and the type of road to be built is definite, the minimum survey requirements would be a projection of the center line and a center line profile. However, on our work we cross-section the greater part of the road mileage.

On certain sections of the road that can be completely graded by the process of machine grading, where practically no material is drifted for completing the road grade, a center line profile will suffice with proper cross-sections at drainage structures. Therefore, with the exception mentioned as machine grading sections, we make a complete detailed survey and prepare definite design plans to follow.

Design: Reconnaissance, Route SB, Cooper County, Boonville South

A recent inspection disclosed the most favorable location for the above described route.

Attached hereto is a part of a Cooper County map showing the layout of proposed line and its relation with other routes.

(Attached to the report is a map, scale 2 miles to the inch, showing all roads and streams, and all houses within the area adjacent to the proposed road which it would serve).

This route receives the rating of a third class road.

From A to B the proposed line follows a county road except for the jog near center of section where a reverse 500′ radius curve is planned. This line is over a light rolling topography near a ridge. A steep grade descends to the crossing of Saline Creek, point B. About 0.3 of a mile of high bottom south of point B. This is a very economical layout.

From B to C coincides with a present gravel road throughout. Easement of two sharp obstructed curves is contemplated. Present road varies in width from 20′ to 26′. Recommend that width in excess of 20′ be maintained.

Structures Used in Place, A to B

8 x 6 x 17′ Concrete Box Culvert
3 x 2 x 18′ Concrete Box Culvert
12 x 6 x 18′ Concrete Box Culvert
3 x 3 x 24′ Concrete Box Culvert

Structures Used in Place, B to C

Bridge over Saline Creek at point B, Heavy steel span, 90 feet long, one I-beam approach on each end 30′ long. Clear roadway 14 feet. Concrete floor and concrete and stone masonry abutments. Excellent condition.

18″ V. C. P. 24′ long with headwalls.
15″ V. C. P. 24′ long with headwalls.
15″ V. C. P. 24′ long with headwalls
30″ V. C. P. 100′ long with headwalls at road intersection.
24″ V. C. P. 27′ long with headwalls.
15″ V. C. P. 30′ long with headwalls.
18″ V. C. P. 27′ long with headwalls.
18″ V. C. P. 40′ long with headwalls.
15″ V. C. P. 40′ long with headwalls.
18″ V. C. P. 30′ long with headwalls.

These structures are in good condition.

Several sharp curves exist between B and C but cannot be eased without cost and damage. Otherwise, present road is in good condition. Point C is the south limits of a paved street in Boonville.

Approximate cost of grading and bridging proposed location, A to C, 20′ roadway.

Section	Length Miles	Grading	Culverts	Bridges	Total Cost
A-B	9.0	$14,700.00	$3,500.00	—	$18,200.00
B-C	4.0	2,700.00	100.00	—	2,800.00
Totals	13.0	$17,400.00	$3,600.00	—	$21,000.00
Plus 10%		1,740.00	360.00	—	2,100.00
Grand Total		$19,140.00	$3,960.00	—	$23,100.00
Cost per mile		1,475.00	305.00	—	1,780.00
		Cost per mile Gravel surfacing, A-B,			800.00
		Cost per mile Gravel surfacing, B-C,			400.00

Note: Hedge pulling on section A-B noticeably increases cost shown for grading.

It is estimated that this road will carry a minimum of 50 vehicles per day.

This line is positively without alternate, it bisects the territory lying between Routes 5 and SD and passes through the most densely populated part of the area to be served, therefore, the proposed layout is recommended.

Mr. Beckett of the Division Office assisted the writer in drawing such conclusion and he is aware of special details planned in the field to promote economy and establish line.

B. F. LESLIE,
Engr. of Spec. Assignments.

Who Has the Longest Paved Tangent?

New Mexico's State Highway Engineer, G. F. Conroy, in the following letter raises the interesting question of what State can claim the highway having the longest tangent. He says:

"We note with interest an article appearing on page 24 of the September issue of PUBLIC WORKS under the heading, 'The Longest Straight Road.' If, as claimed by 'Mississippi Highways,' this road has the distinction of being one of the longest, straightest paved highways in the world, then New Mexico must claim this distinction in that we have a 32.012-mile tangent bituminous surfaced road, located in southwestern New Mexico on U. S. 260 between Deming and Silver City."

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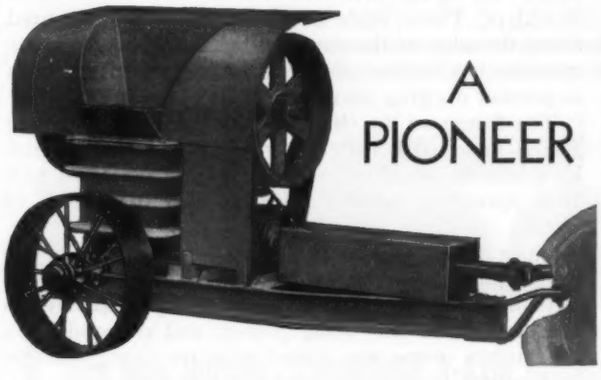

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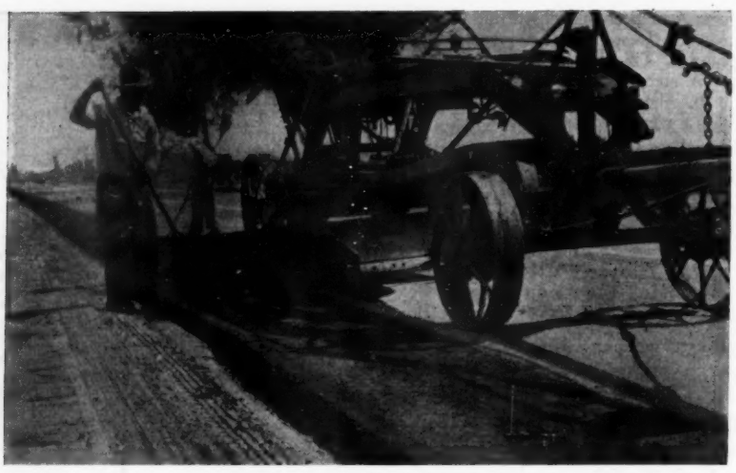


Grader and Blade Attachments

A CONTRACT on a portion of State Highway 4 in Fresno County, California, which was accepted in June, 1935, provided for the construction of one mile of 20-foot asphalt concrete pavement with 3-foot by 5-inch oil-mixed crushed rock borders. The contractor used special attachments to the standard spreader box and grader blade for placing the rock borders, which may be of interest to others engaged on similar work.

The standard 8-foot spreader box was equipped with two steel shoes bolted to the bottom of the box, one of which rode on the pavement and the other on the earth shoulders. These shoes had a flange which followed along the edge of the pavement as a guide to keep the spreader box in line; the front ends were curved back to prevent digging into the asphalt pavement.

The flange on the outer shoe on the earth shoulders forced loose earth material which fell into the trench back into the shoulder, and also kept the crushed rock from spreading beyond the 3-foot required width of trench.

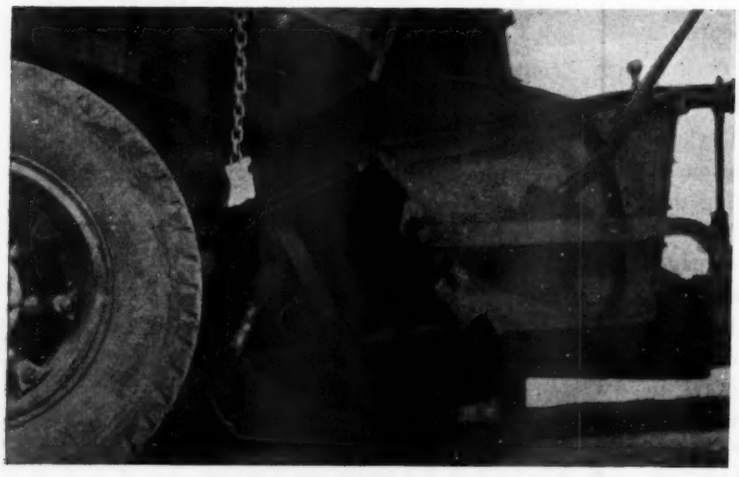
Since the 6-inch rock borders were placed in two courses, the outer shoe was made in two parts, the lower part of the flange being bolted to the upper part when the base course was being placed, and removed when the surface course was placed so as not to dig into the base course.

The 2.5-foot spreader blade which was attached to the regular adjustable blade of the spreader box successfully spread the material in the 3-foot trench. The spreader box chains were fastened high on the trucks in order to raise the front ends of the shoes about 1½ inches, thus causing the weight of box to be partially carried by the truck and prevented gouging of the earth shoulders.

One-quarter-inch steel plates were fastened inside the spreader box on each end, forming two false sloping sides or inclined planes, and leaving a 2.5-foot opening in the middle of the box. As the material was dumped into the spreader box, these plates forced it through the opening and spread it the full 3-foot width of border. It was found, however, that a 2-foot opening would have been wide enough to fill the 3-foot trench.

As specified in the special provisions, the rock borders were laid in two courses. The base course was rolled with a loaded dump truck and it was found that this compacted the mixture more satisfactorily than a roller, because the truck tire rolled all portions of the trench, pushing sideways as well as downward, and a much better bond was obtained between the pavement edge and the border.

The grader was equipped with two winged flanges set vertically and perpendicular to the plane of the blade surface. One wing was attached to the end of the blade and the other 3 feet from it. The action of the blade and wings was similar to that obtained by the screeds of a mechanical finisher, as the compartment made by the blade and wings was kept full of material at all times and fed or cut as the surface required.



Spreader Box with Special Attachments

The rock border was left ¼ inch higher than the edge of pavement; hence when the grader blade passed over the border some material fell onto the pavement. A small wooden drag was attached behind the blade on a slight angle with the outside and even with the edge of the pavement, and this drag pushed the scattered material back onto the border. After the material was allowed to cool and set for some time, it was given a final rolling, the above methods resulting in a very good appearing job.

F. W. Howard was resident engineer in charge of this contract.

For the above description and illustrations we are indebted to "California Highways and Public Works."

Road Improvement and Maintenance Suggestions

Preparing Roads and Streets for Winter

Where drainage channels on highways and streets clog so that water flows across the highway, or stands in pools alongside of it, then when cold weather follows close after a rain, or after a thaw with snow on the ground, these spots become sheets of ice which are dangerous to traffic. Of course, cinders mixed with calcium chloride or salt can be used, but prevention is better.

During or immediately after a heavy rain, send an inspector out in a car to note these places. Because there is often little trace of them after the water has run off, it is best to mark with a numbered stake or other indicator each spot and to make full notes as to suggested treatment. If the inspector has a closed car, such work is not too trying, even in very bad weather.

The defect found may consist of a blocked ditch or culvert, which backs up the water so that it covers a portion of the road, or flows over the road. The remedy for this is usually to open and clean the ditch or culvert. Or the difficulty may be caused by the road shoulders being higher than the surface of the highway, in which case a pool will form along the edge of the road. The treatment in this case is to grade down the shoulders; or, if this can not be done at once, to cut ditches across the shoulder at intervals.

On hills, due to high shoulders or imperfect ditches, water may be diverted from the higher side of the road to the lower side, flowing in a thin stream across the surface. Such conditions are very conducive to slippery places in the winter, with accompanying accidents. The conditions found will usually indicate the treatment to be received.

On some two- and three-lane concrete surfaces, water may ooze up through the longitudinal joint and flow across, or down the center of, the highway for some distance before turning off into the ditch. These areas create especially dangerous conditions in cold weather, since they usually occur on a hill. Trenching along the sides of the road, and the installation of a perforated or other drain pipe to cut off the underground flow of water, will usually remedy this condition.

Uneven or Badly Settled Sidewalk or Street Slabs May Be Dangerous

In every city, no matter how careful the original construction, there are pavement slabs, sidewalk slabs and curb and gutter blocks which have settled badly out of their proper position. Often these are hazards to the pedestrian; sometimes they are merely unpleasant for the motorist; nearly all are unsightly.

A good job for an engineer is to locate all such places —in a smaller city one engineer can do this; in a larger city, it is best to divide the city into districts and assign one or two engineers to each district. They should check the sidewalks for badly settled slabs, the streets for uneven concrete pavement slabs, and the curbs for

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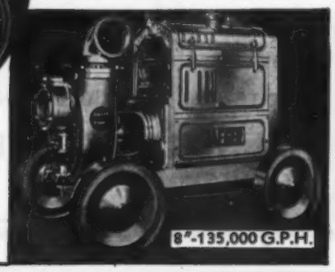

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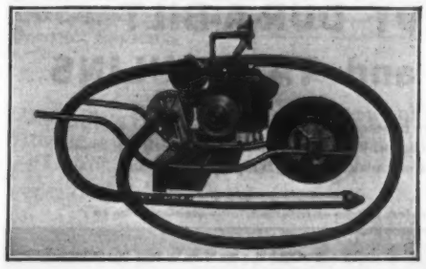

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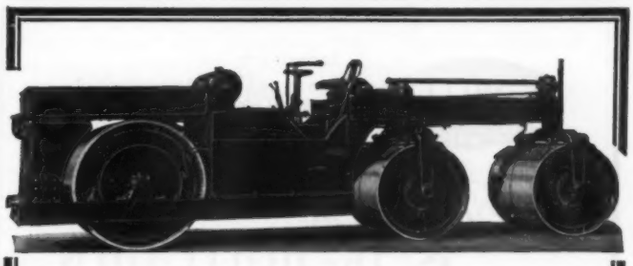

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blocks that are settled below the level of the adjacent street surface. These should be recorded in notebooks, by streets and blocks, and fully described so that the repair crew can locate them.

There are a number of ways of repairing these defects, but if the slab is not broken, the use of the mudjack seems to be the most economical and satisfactory. A number of cities have reported on experiences with this equipment, and it has been generally found that it is much cheaper than any other means, and gives excellent and lasting results.

The Editor will be glad to have sent, on request, information regarding costs of such repairs. See also PUBLIC WORKS, October, 1935, page 33.

Sidewalks Along Highways Are Badly Needed

Most of us consider sidewalks as necessary along city streets, but few realize how badly needed similar walkways are along many of our highways, especially those which pass through small communities or semi-builtup sections. Walking hasn't entirely passed into discard, but it has become a hazardous occupation when practiced along roads carrying any amount of motor traffic.

This hazard is, of course, intensified at night. A person wearing dark clothes and shading his face from the glare, is difficult to see at any time; when meeting another car, it is practically impossible for a motorist to be sure that a pedestrian is not walking on the edge of the road ahead of him.

Today when the WPA will provide labor without cost, is the time for cities, counties and states to do their bit toward reducing pedestrian highway accidents by building walkways along highways. Such work is very well suited to WPA, in that but little material and even relatively few tools are needed—the requirements being principally for labor. Walkways can be built of asphalt or tar on a broken stone or gravel base, using a concrete mixer to produce the surfacing from aggregate and bituminous material. Old brick, torn up from streets or salvaged from buildings, can be laid for walks; artistic and useful walks can be built of native stone (the writer has several hundred feet of such walks on his place which he built himself). Even gravel, cinder or similar walks are preferable to none.

In an early issue we will publish more detailed directions for constructing bituminous walks.

Make Bridges and Culverts More Visible at Night

Bridges on state highways are usually fairly well marked and many of them are painted to insure visibility at night. On many county and town routes, this is not the case, and steering a safe course on a rainy night with the glare of oncoming headlights in the driver's eyes is much more difficult if the bridge is the color of that stack of proverbial black cats.

The members of through bridges ought to be painted aluminum or white, and the same treatment given to rails and guards on deck bridges. Where culverts are not the full width of the roadway, including shoulders, the headwalls may be marked with posts painted with aluminum or white paint.

Highway safety can be accomplished through no short cut, or by no single piece of magic, but only by attention to all the innumerable details that contribute to making driving hazardous. Proper marking of bridges and culverts for night driving is one of these. The Editor will be glad to send on request information regarding such painting of bridges.

The Digestion Tank

A Digest of the Sewerage Literature of the Month giving the main features of all the important articles published

THE Nordell Number, used in connection with equations given in a paper by Kessler and Nichols, is believed by them to "provide the plant operator of an activated sludge plant with a simple means of determining sewage strength, the stage of oxidation, and the condition of activity of sludge within a short period of time—usually less than one hour." "Activated sludges must be given the required amount of free oxygen, and as the treatment process progresses this quantity can be decreased in accordance with the Nordell Number obtained."

The "Nordell Number" (named for Carl H. Nordell, formerly engineer of design for the Milwaukee Sewerage Commission) is the rate of oxygen utilization per hour, in parts by weight of oxygen per million parts of liquid sludge. The method of determining this rate consists essentially of noting oxygen depletions in sewage-sludge mixtures during periods of a few minutes and converting these to rates per hour; the length of period being that found by trial to cause a depletion of about 2 ppm of dissolved oxygen—generally 3 to 10 minutes.

This rate "can be used to ascertain the progress of oxidation of the sewage as it passes through the activated sludge treatment process." An equation was developed which "provides a means of finding the time necessary for a completion process" and "permits the determination of sewage strength comparable with B.O.D. within a period of one hour.[C11-3]

Apparatus for direct determination of oxygen absorption was developed recently by Mr. Nordell, primarily for determining the efficiency of mixtures of activated sludge and raw sewage, but Burtle and Boswell "have tried to adapt it to the determination of B.O.D. to effect a saving in time and to reduce the cumbersomeness of the dilution method, . . . and hope to discover a relationship between the biochemical oxygen demand as obtained by the dilution method, and the direct absorption as determined from the Nordell Number, which will allow the development of a formula for calculation of results which will be applicable to all types of waste."[C11-4]

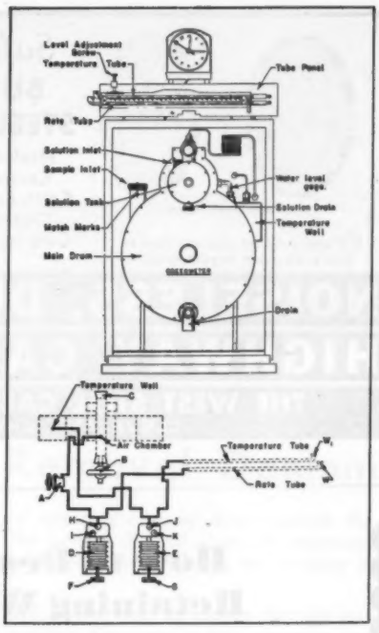
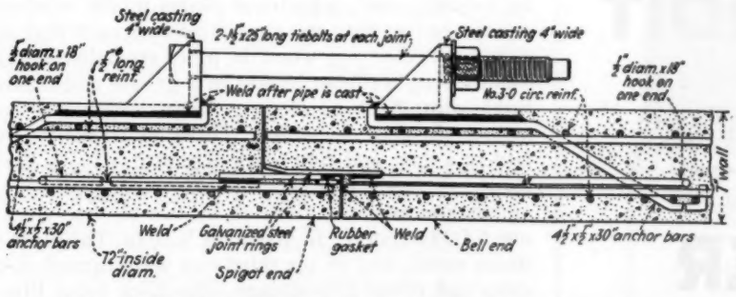


Diagram of Nordell Oxygen Demand Apparatus

Thermophilic digestion followed by mesophilic was studied at the Freehold, N. J., treatment plant during several winter and spring months, the thermophilic tank being kept at 130° F. and the mesophilic at 80°-84°. Among the deductions were the following: In the *thermophilic* tank the reduction of volatile matter varied in general with the time of digestion, the relationship being 53X—5Y=80 (X is digestion time in days, Y is percent reduction in volatile matter). Gas produced per pound of volatile matter ranged from 25 to 12.9 cu. ft., average 17.5, in December; average 19.3 in April-May. In the *mesophilic* tank there appeared to be no proportional relationship between reduction of volatile matter and digestion time. The gas produced per pound of volatile matter (treating effluent of thermophilic tank) was 59% to 74% less than in the thermophilic tank.

"The results seem to warrant the conclusion that, with twelve days of digestion, five in the thermophilic tank and seven in the mesophilic tank, adequate digestion of fresh solids will take place to a degree usually obtained only after thirty days with the mesophilic process alone." The pH value should be maintained above 7.6—low pH values are severely detrimental to volatile matter reduction. The ripe sludge was equal if not superior to single-stage mesophilic 30-day sludge in good drainability and lack of odor. The daily load handled most efficiently was 14% of the amount of ripe sludge present, on a volatile matter basis.

To prevent baking of the sludge on the heating coils in the thermophilic tank, a variable-speed circulating pump will permit using water of lower temperature in the coils. "The advisability of a stirring mechanism cannot be too strongly stressed," to insure thorough heat distribution and prevent layer effect when fresh sludge is added, and to seed the fresh solids quickly, and prevent the formation of thick scum. It is desirable to pre-concentrate and decant the fresh solids before their addition to the digestion tank, pre-heating them to the temperature of that tank and inoculating with ripe sludge; thus requiring smaller tank capacity and producing less supernatant digestor liquor to be returned to the settling unit, and giving less liquid to be heated.[C11-1]



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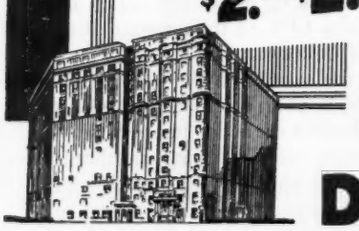

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Activated carbon was found, by laboratory and plant experiments, to raise the pH and reduce the total acidity of sewage, due to the adsorption of carbon dioxide and volatile fatty acids. It did not aid in flocculation of suspended solids in sewage, nor in the flocculation of solids with ferric chloride. It reduced the efficiency of chlorine as a sterilizing agent. No increase in purification by activated sludge treatment was caused by the addition of carbon. In digestion tanks, the carbon materially accelerated the digestion of sludge of poor quality, sludge containing toxic materials, or improperly seeded, or that digesting at low temperature; gas production was increased, volatile matter reduction was greater, the pH value was maintained at a higher level, carbon dioxide in the gas was lower, and the rate of dewatering of digested sludge was increased in proportion to the amount of activated carbon added; and a better separation of sludge and liquor was attained, with a wider supernatant liquor zone and less solids in the liquor. The B.O.D. of raw sewage and highly oxidized effluents was not reduced by activated carbon, but that of incompletely oxidized effluent and effluent from chemically treated sewage was reduced. Scum formation on settling tanks was materially reduced by the activated carbon. Odor reduction was obtained, but storage of sewage with activated carbon accelerated H_2S production. Not all activated carbons are equally effective in reduction of acidity and volatile fatty acids.[C11-5]

Digesting activated sludge was studied at Manchester, England, by Ardern and Lockett, who found it "unattractive," whether in a mesophilic or thermophilic tank because of low gas yield and also, in mesophilic digestion, of the difficulty of maintaining the optimum pH of the digesting sludge. Adding 10% (by volume) of tank sludge to activated sludge increased the gas yield twofold, but did not insure complete stability with mesophilic digestion; but with 15% of tank sludge added, the m.r.t. digestion presented no difficulties, the gas yield increased threefold, and a satisfactory pH of the sludge was obtained. To reduce the bulk of sludge, further treatment is necessary; for mesophilic sludge, 10 to 20 days' further detention in tanks at atmospheric temperature gave a good separation of water, as did 5 days for thermophilic sludge. They found that thermophilic tanks digested activated sludge alone or with either 10% or 15% tank sludge, in half the time required in mesophilic tanks.[D9-3]

The outfall sewer of the Coney Island (New York) treatment plant is 72 in. in diameter and 8,200 ft. long, of which 6,375 ft. is under water. The pipe is of reinforced concrete 7″ thick containing two cages of reinforcing. They were made in 24 ft. lengths, weighing 22 tons; and two lengths were bolted together on the scow and laid as a 48 ft. length. The joints were made by welding steel cylindrical plates to the reinforcing at each end so that one ring telescopes over that at the end of the other pipe when the pipes are pulled together, compressing a rubber gasket in a groove and making a tight joint. Each succeeding 48 ft. length was bolted to those in place by divers. Three 48 ft. sections were laid in a day, and four were poured in day, in vertical forms. A fairly dry concrete was used, with 1″ stone aggregate, and was vibrated by two electric vibrators, one 6 ft. and one 12 ft. above the bottom. The pipes were steam cured, and on the third day were turned on their sides and rolled into storage. The Lock Joint Pipe Co. made the pipe. They were laid by the Merritt-Chapman & Scott Corp. [E11-1, 3]

Bibliography of Recent Sewerage Literature

To find an indicated reference, find the given letter and bold-face number at the left of the column, and the light-face number (following the dash) immediately below this. The bold-face number indicates the month of issue of Public Works in which the article was listed, which is generally the current but may be a previous one.

c, Indicates construction article; *n*, note or short article; *p*, paper before a society (complete or abstract), *t*, technical article.

C 11 — *Sewage Works Journal* — *September*

1. *t.* High and Low Temperature Digestion Experiments: Consecutive Digestion. By E. J. Cleary, pp. 781-797.
2. *t.* Digestion of Human Fecal Matter, with pH Adjustment by Air Control (With and Without Garbage) by S. Nishihara, pp. 798-809.
3. *t.* Oxygen Utilization by Activated Sludge. By L. H. Kessler and M. S. Nichols, pp. 810-838.
4. *t.* Comparison of Permanganate Oxygen Demand, B. O. D. and Direct Absorption of Oxygen. By J. Burtte and A. M. Buswell, pp. 839-851.
5. Activated Carbon in Sewage Treatment. By W. Rudolfs and E. H. Trubnick, pp. 852-881.
6. Gas Collection and Sludge Heating. By H. L. Kinsel, pp. 882-905.
7. Beautifying the Sewage Treatment Plant. By L. E. Burnside, pp. 906-910.
8. Starting Up Two Activated Sludge Plants at Lancaster, Pa. By J. F. Laboon, pp. 911-914.
9. Sampling Procedure for Trickling Filter Investigation. By R. L. Johnson, pp. 915-918.
10. Chemical Precipitation. By M. J. Blew, pp. 919-927.
11. *p.* Study of Grit Chamber of Werdholzli, Zurich, Treatment Plant, pp. 939-940.
12. *p.* New Activated Sludge Plant at Toyohashi, Japan, pp. 952-954.

D 11 — *The Surveyor* — *October 4*

1. Chemical Precipitation in Glasgow, pp. 353-354.

October 11

2. Smells from Sewage Disposal Works. By C. L. H. Humphreys, p. 371.

E 11 — *Engineering News-Record* — *October 10*

1. Treating Coney Island's Sewage, pp. 489-493.
2. Partial Treatment Advised for San Francisco Sewage, p. 495.
3. Casting 72-Inch Concrete Pipe in 24-Foot Sections, pp. 493-494.
4. Recent Sewage Plant Developments Call for Fresh Approach to Design Problems. By S. A. Greeley, pp. 501-502.
5. Nationwide Control of Water Pollution Proposed, pp. 505-506.

October 17

6. Cahokia Creek Diversion and East St. Louis Drainage. By H. Shifrin, pp. 525-529.

G 11 — *Water Works and Sewerage* — *October*

1. New Northside Sewage Treatment Works of Durham, N. C. By W. M. Piatt, pp. 337-343.
2. New Sewage Treatment Plant of Walden, N. Y. By N. L. Nussbaumer, pp. 355-358.
3. Sewer Cleaning with Rubber Beach Balls. By A. M. Rawn, pp. 359-360.
4. Experience with Chlorination of Activated Sludge. By E. E. Smith, pp. 362-364.

H 11 — *Municipal Sanitation* — *October*

1. Gas Stored under Pressure at Beaver Dam Sewage Plant. By J. Donohue, pp. 292-293, 298.
2. Underground Sewage Pumping Plant at Los Angeles, pp. 294-295.
3. Town of 4,000 Population (Monett, Mo.) Gets Complete Treatment Plant. By M. L. Crist, pp. 303-304.

J 11 — *American City* — *October*

1. Sewage Treatment by Chemical Precipitation. (Oklahoma City). pp. 41-42.

M 11 — *Canadian Engineer* — *October 15*

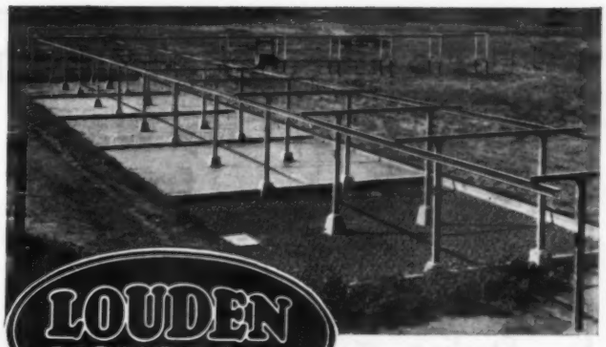
1. *p.* Review of Ontario Sewage Disposal Practice. By A. E. Berry, pp. 21-24.
2. Operation of the York Township Sewage Disposal Plant. By C. Chamberlain, pp. 25-27.
3. Corrosive-Resistant Metals Required in Sewage Plants. p. 28.
4. Operation of Guelph's New Activated Sludge Sewage Plant. By H. S. Nicklin, pp. 29-32.
5. Operation of the North Toronto Sewage Treatment Works. By G. Phelps, pp. 33-34.
6. Operation of Kitchener's Two Sewage Disposal Plants. By S. Shupe, pp. 35-36, 40.
7. *p.* Use of Chemicals in Treatment of Sewage. By F. M. Veatch, pp. 41-43.
8. Mechanical Filtering of Sludge at East York Township Plant. By G. R. Jack, p. 44.

P 11 — *Public Works* — *October*

1. Chemical-Mechanical Treatment of Sewage. By P. B. Streander and M. J. Blew, pp. 15-16.
2. Experiments in Chemical Sewage Treatment at Liberty, N. Y. By W. A. Hardenbergh, pp. 31-32.
3. *p.* State Hospital Sewage Disposal Works. By H. Ryon, p. 33.
4. Operating Schedule for Activated Sludge Plant, pp. 43-44.
5. *n.* Activated Sludge Treatment at the Davyhulme Plant, p. 45.
6. *n.* Thermophilic Digestion of Activated Sludge, p. 45.

T 11 — *Technique Sanitaire* — *September*

1. Le Probleme de la Securite dans les Egouts. By M. Bertharion, pp. 228-234.



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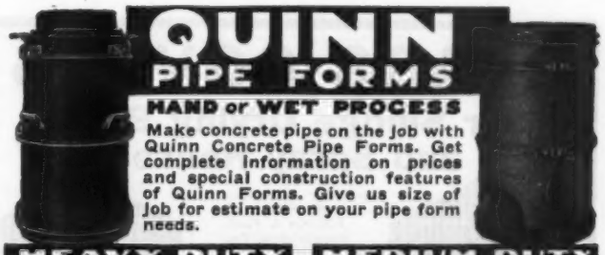

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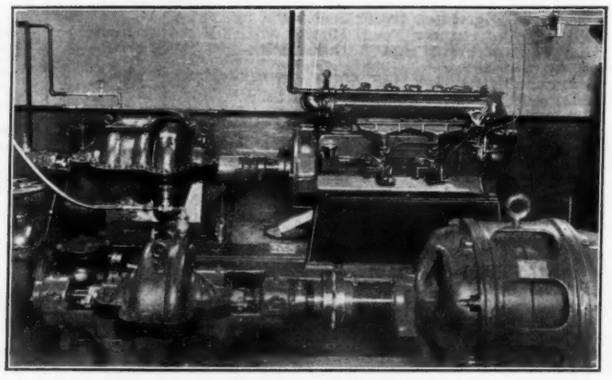

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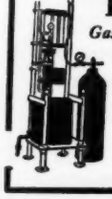

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Following is a digest of the important articles published last month having to do with water works design, construction and operation and water purification, arranged in easy reference form.

The Water Wheel

EXCESS lime hydrate's effect on corrosion of iron pipe and on other materials was studied by Hale, the pipe tested being Byers, Reading and galvanized wrought iron pipe; brass, red brass, copper, and cement-lined steel; all tested with cold water and all but the steel with water at 150° F. as well. Lime hydrate excesses of 10 ppm, 50 ppm and 100 ppm were used for most of the metals. The various tests ranged from 205 to 612 days continuous flow. The cement-lined steel pipe, after various tests totaling four years, shows very little effect, and brass and red brass after six years were still in good condition. In the case of black w.i. pipe, the effect of water just neutralized was practically the same as that of raw, but all the excess treatments showed rapid and steady drop in oxygen consumption. In galvanized pipe, even using exactly neutral water, the oxygen consumption was well below that of raw water. In general, not more than 10 ppm excess lime hydrate is desirable. It thus appears possible to treat a soft low-alkalinity water containing little free carbon dioxide with a moderate excess of hydrate and greatly reduce the corrosion of black iron, galvanized iron, and even brass, copper and possibly other metals; but careful regulation of the amount of excess lime should make it possible to avoid building up a calcium carbonate deposit sufficient to interfere seriously with the flow capacity of the pipes. Also it would sterilize the water. The U. S. Public Health Service has said that "water should contain no caustic alkalinity," but it seems unlikely that a small excess of lime hydrate alkalinity in drinking water would have any deleterious effect on health; and none on taste where the excess is under 50 ppm.[A11-10]

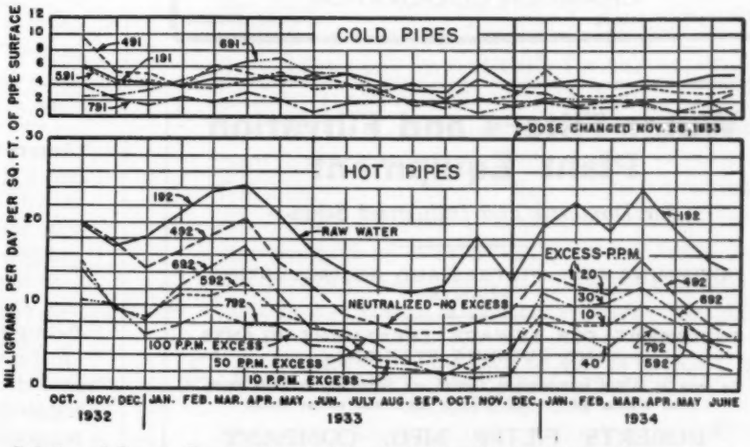
Quality of zeolites can be learned more reliably by experience than by any laboratory tests in use. But comparative qualities of various zeolites can be determined by laboratory tests of: 1—grain size and percentage of fines; 2—weight per cubic foot of zeolite as received; 3—resistance to attrition loss; 4—ratio of alumina to silica (especially applicable to synthetic zeolite); 5—exchange value and percentage of expansion on back washing. (1) is determined by screening; (2) is determined after back washing; (3) by revolving with pebbles in a ball mill; (4) is determined because softening capacity increases with the ratio of alumina to silica; by (5), operating exchange or capacity is determined by actual operation of a small unit—say one 2″ diameter and 24″ deep.[A11-8]

Algae produce oxygen in water. Minute cells of green algae, sufficiently numerous to tint the water a scarcely perceptible green, and under average daily conditions as to sunlight, produce measurable amounts of dissolved oxygen. In tests made on heavily polluted water, with atmospheric aeration eliminated, when there were bacteria present but no algae, there was a serious decrease in dissolved oxygen; but when there were also minute algae, there was a similar decrease at first, but recovery and replacement soon developed, and about the third day dissolved oxygen began to increase, sometimes reaching supersaturation. Where there were algae cells but no bacteria, there was no decrease of initial dissolved oxygen, but a progressive increase, corresponding in general with the daily increase in algae cells. When kept in darkness in the 20° C. incubator, there was no effect on growth of bacteria, but there was no increase in algae or replacement of dissolved oxygen.

The oxygen produced by algae, being essentially pure, has a vapor pressure about 5 times that of atmospheric oxygen; consequently the dissolved oxygen content of lake or reservoir water during the day may be largely algae-produced oxygen, and this should be kept in mind when collecting samples to learn average 24-hour conditions.[A11-3]

Consumption in apartment houses in Atlanta, Ga., according to a 12-month water record of 32 such houses containing 1167 apartments averaged 204 gals. per day per apartment, ranging from 112 to 436 gals. It was estimated that there was an average of 3 occupants per apartment. If we assume 2 and 4 occupants respectively in the extreme cases, we get per capita consumption between 56 and 145gpd.[G10-5]

Rolled-fill dams now compete economically with hydraulic fill, because of improvements in mechanical equipment, and are more free from unpredictable failure during construction. Standardized earth-testing methods permit scientific selection of materials. "The requirements for suitability of material for the impervi-



Relation of Oxygen Consumption in Galvanized Wrought Iron Pipe to Excess Lime Hydrate in Various Amounts. Cold and Hot Reaction

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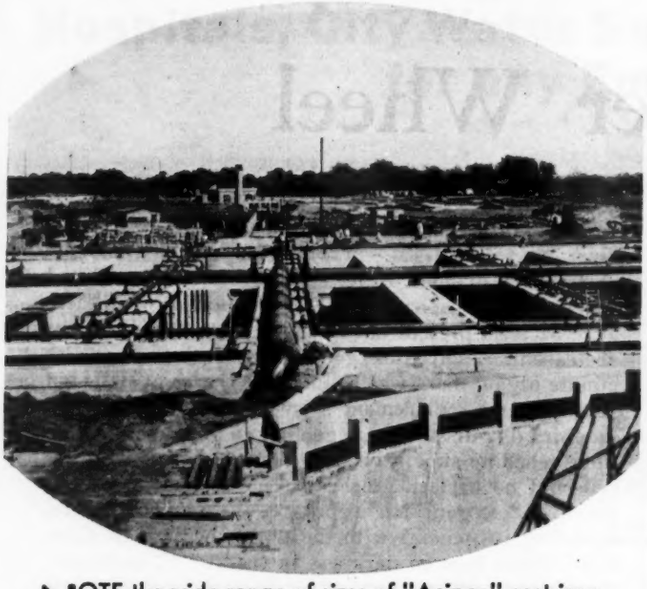

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ous part of a rolled-fill earth dam are: (1) permanent stability, (2) reasonable watertightness, (3) workability, (4) insolubility, and (5) reasonable cost." There is an intimate relation between the first three (which are the most important) and the mechanical composition of the material, suggesting use of mechanical analysis as a preliminary basis for selection of material; to be supplemented by more positive tests, such as those for compaction and permeability.[L10-3]

Contract prices for constructing earth dams with concrete cores near Hartford, Conn., under similar specifications, in 1915, 1933 and 1935 show trend of costs, in that section of the country at least, during past 20 years. The averages of bids per cubic yard for the different principal items received on each of these three occasions were as follows, given in the order of 1915, 1933 and 1935. Earth excavation—48c, 39c, 35c. Riprap—$1.71, $2.06, $1.60. General fill, 12″ layers—46c, 31c, 30c. General fill, 8″ layers—46c, 36c, 31c. Soil core and blanket—61c, 45c, 62c. Selected fill, 6″ layers—61c, 41c, 33c. Concrete corewall—$4.11, $5.28, $5.01. Portland cement, per bbl.—$1.71, $2.39, $2.46. The lowest bids for each item (not the bids of the lowest bidder) were: Earth excavation—35c, 29c, 18c. Riprap—$1.00, $1.00, 95c. General fill, 12″ layers—27c, 20c, 23c. General fill, 8″ layers—27c, 23c, 23c. Soil core and blanket—40c, 22c, 40c. Selected fill, 6″ layers—40c, 23c, 28c. Concrete corewall—$3.00, $3.89, $4.00. Portland cement—$1.50, $2.29, $2.25. Cement and concrete are seen to be the only items not lower this year than in 1915.[E10-3]

Concrete construction at Morris Dam totaled 500,000 cu. yds., with 5,000,000 lb. of reinforcing steel. Concrete in the dam proper had a slump of less than 1 in.; that in the spillway and abutment 3 to 5 in. All was vibrated. Aggregates were hauled by rail 2 mi. to the mouth of the canyon; thence by aerial cableway 10,200 ft., with 500 ft. rise, and dumped into bins over the batching plants. Bulk cement was hauled by truck to base of dam, as much as 80 mi. and 400 tons a day, dumped into a hopper, and transported by screw conveyor and bucket elevator to a 4,000 bbl. steel silo, thence pumped through 800 ft. of 5 in. pipe, with 300 ft. lift, to mixer bin. Concrete was placed by 2 cableways 960 ft. long in 4 cu. yd. buckets. (For track cables, 2½ in. lang-lay hemp-center wire ropes wore excessively and were replaced successfully with 2¼ in. lock-coil cables.) Concrete was mixed 3 min.; time of mixing and placing averaged 3¾ to 4 min. per 4 cu. yd. batch, Both internal and surface vibrators were used. The 50-cycle current available did not give efficient operation—75 cycles gave greatest efficiency. For softer mixes used in reinforced concrete, internal vibration alone sufficed.[L10-1]

Concrete was pumped for the corewall of the Bills Brook dam, Hartford, now under construction, 28,000 cu. yd. being delivered at an average rate 25 yd. per hour and a maximum rate of 35 yd., the longest distance pumped being 850 ft. and the maximum lift 20 ft. Concrete was of 2,000 lb. compressive strength, 1:7 mix with 7.5 gal. of water, delivered from 1-yd. mixer through an inclined chute to a 2-yd. remixing hopper (to prevent segregation) the base of which was connected to a concrete pump, which discharged through toggle-jointed 7″ steel pipe. Pumping automatically regulated the consistency of the concrete, for if it was too sloppy the aggregates settled in the pipe, if too stiff it plugged it, in either case stopping delivery.[E10-3]

Bibliography of Recent Water Works Literature

To find an indicated reference, find the given letter and bold-face number at the left of the column, and the light-face number (following the dash) immediately below this. The boldface number indicates the month of issue of Public Works in which the article was listed, which is generally the current but may be a previous one.

c, Indicates construction article; *n*, note or short article; *p*, paper before a society (complete or abstract), *t*, technical article.

A 11 *Journal, American Water Works Ass'n.*
September
1. *t.* Determining the Bacteriological Quality of Drinking Water. By J. K. Hoskins and C. T. Butterfield, pp. 1101-1109
2. *t.* Limiting Standards of Bacterial Quality for Sources of Purified Water Supplies. By H. W. Streeter, pp. 1110-1119.
3. *t.* Results of Algal Activity, Some Familiar, Others Obscure. By W. C. Purdy, 1129-1133.
4. *t.* Study of Selective Media for Coli-Aerogenes Isolation. By C. C. Ruchhoft and J. F. Norton, pp. 1134-1142.
5. *t.* The Relative Productivity of Certain Culture Media. By R. E. Noble, pp. 1143-1160.
6. Preparation of Fine Anthracite Coal for Use in Filter Plants. By E. L. Buller, pp. 1161-1165.
7. *t.* A Colorimetric Method for the Determination of Dissolved Oxygen. By F. W. Gilcreas, pp. 1166-1177.
8. *t.* Tentative Methods for Testing Zeolites. Committee Report, pp. 1178-1185.
9. Acid Mine Drainage Control on Upper Ohio River Tributaries. By E. S. Tisdale and E. W. Lyon, pp. 1186-1198.
10. *t.* Effect of Excess Lime Hydrate upon Corrosive Soft Water. By F. E. Hale, pp. 1199-1224.
11. Chemical Hazards in Water Works Plants. Committee Report, 1225-1248.

D 11 *The Surveyor*
September 20
1. Afton Reservoir, Ayrshire, Scotland, pp. 291-292.
2. The Marchlyn Water Scheme of Gwyrfai, Wales, pp. 294-295.

September 27
3. Market Harborough Water Supply. By J. G. Barlow, p. 341.

October 4
4. Lancaster's New Reservoir, p. 356.

October 11
5. Riveted Pipe Lines for Water Supply. By E. W. Howells, p. 380.
6. Waterworks of Leek, p. 383.

E 11 *Engineering News-Record*
September 26
1. Bell and Spigot Joints Tested at Ohio State University, p. 429.
2. Hydraulic Research at Iowa University, pp. 433-437.

October 10
3. Grouting Checks Leakage in Earthfill Dam. By E. M. Wilbur, pp. 499-500.
4. *c.* High-Speed Tunnel Driving in Soft Material at Pasadena, pp. 513-514.
5. Developing Well Water Sources at Tacoma, Wash., pp. 514-515.

F 11 *Water Works Engineering*
October 2
1. *p.* How Can the Consumer Be Satisfied? By W. L. Eisert, pp. 1130-1133.
2. *p.* How a Mud-Clogged Distribution System Was Cleaned. By C. Streithof, pp. 1134-1135.

October 16
3. Diesel Engine Exhaust Used in Water Softening. By P. Stegeman, pp. 1182-1184.
4. Deep Well Units for Argentina. By W. F. Schaphorst, pp. 1185-1186.

G 11 *Water Works and Sewerage*
1. Blowing Out Service Lines. By S. H. Davis, pp. 344-345.
2. Corrosion Control with a Marble Filter. By H. Ryan, pp. 360-361.
3. *p.* Operations in the Jacksonville Water Meter Department. By J. E. Hening, pp. 365-367.

J 11 *American City*
October
1. *p.* Progressive Watershed Control by Planning and Zoning. By M. W. Cowles, pp. 45-46.
2. Water Rates and Service Charges in 16 Cities, pp. 79, 81, 83, 85, 87.

P 11 *Public Works*
October
1. Equipment Used in Water Purification, pp. 9-11.
2. Rehabilitation of Buffalo Water System. By A. D. Drake, pp. 17-18.
3. *p.* Keeping Filter Sand in Good Condition, pp. 44-45.
4. *n.* St. Paul Water Works Notes, p. 45.

S 11 *Construction Methods*
October
1. Enamel-Lined Welded Pipe at Hamilton, Ont. By A. Le Feber, pp. 48-49.

W 11 *Johnson's Nat'l Drillers Journal*
Sept.-Oct.
1. Laws Regulating Well Drilling Now in Effect, pp. 1-6, 14.

HH 11 *Proceedings, Maryland-Delaware Water & Sewerage Ass'n.*
Year 1935
1. Comprehensive Planning for Water Supply and Sewerage Systems in Maryland. By James R. McComas, pp. 16-24.
2. Materials for Use as Salt Water Pipe Lines. By W. C. Stewart, pp. 28-66.
3. The Pines-on-the-Severn Water Plant. By W. C. Munroe, pp. 67-73.
4. Experiences with Micro-organisms in the Washington Water Supply. By G. E. Harrington, pp. 74-86.
5. New Water Purification Works at Burnt Mills. By R. B. Morse, pp. 87-105.
6. Use of Water for Air Conditioning and Refrigeration. By A. R. McGonegal, pp. 106-110.

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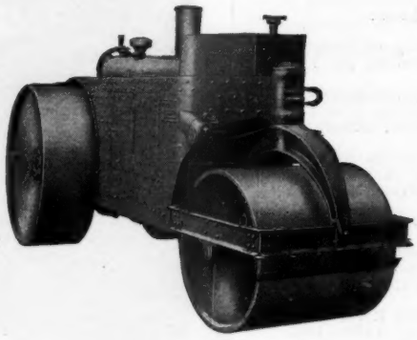
Davenport Diesel Roller:

A new Diesel powered roller is announced by the Davenport-Besler Corporation of Davenport, Iowa. These are furnished in 10 and 12-ton units. They are powered with Caterpillar D-6100 Diesel engines and have embodied in them other Caterpillar standard parts.

Strictly one-man operation is claimed for these rollers which have four speeds forward and four reverse, with a speed range of .92 to 5.02 miles per hour.

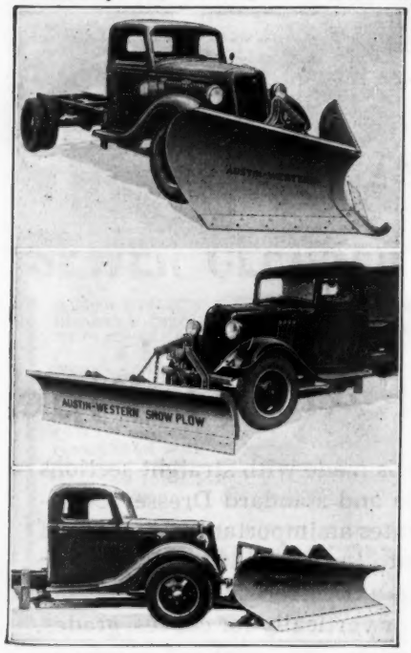
The wheels are of all-steel, heavy welded construction, accurately machined round and true. All wheels are designed to receive liquid or solid ballast to permit temporary increases in weight where circumstances demand.



Davenport Diesel Roller

Austin-Western Snow Plows:

A new line of plows, built to match the power output of trucks in the Ford and Chevrolet class, has just been announced by the Austin-Western Road Machinery Co., Aurora, Ill. These are



carefully designed and fabricated to secure balance and strength and are curved to handle a maximum volume of snow with a minimum expenditure of power.

All excess power consuming weight has been avoided to increase truck speed, to prevent injury to front of truck and to permit easy and quick attachment or removal as desired.

The V-Type (top), Reversible Straight Blade (center) and One-Way Tapered Blade (bottom) use the same frame and are interchangeable. Features available on these plows include rubber tired, caster wheels, safety spring release, and means to adjust pitch and plowing angle of blades.

Personals:

Robert N. Clark, Kenmore, N. Y., formerly sanitary engineer, Innis, Sperden & Co., is now on the staff of Floyd Browne, consulting engineer, Marion, O.

Victor J. Brown, co-author of "Low Cost Roads and Bridges," has been promoted to the rank of Major, Engr. Res., and appointed to command a CCC subdistrict in Wisconsin.

Lowell O. Stewart, formerly associate professor of sanitary engineering, Iowa State College, Ames, Ia., has been appointed personnel officer for the division of engineering of that college.

Walter H. Gardner, formerly manager of special sales, Caterpillar Tractor Co., has become general sales manager of the Keystone Steel and Wire Co. Paul Weeks succeeded to his place in the Caterpillar organization, and will have as assistants C. L. McMullen and G. E. Spain.

Frank Liebich has been appointed district manager, Detroit, for the Harnischfeger Corp., Milwaukee.

Don S. Walker has been appointed district manager in Philadelphia for the Combustion Engineering Co.

George E. Hillsman has been made sales manager of the American Concrete Expansion Joint Co. of Chicago.

Kentucky Rock Asphalt Institute

George Rapp, Vice President of the Ohio Valley Rock Asphalt Company, was elected to the Presidency of the newly formed Kentucky Rock Asphalt Institute at its organization meeting held in the Institute offices, Marion E. Taylor Building, Louisville, Ky., on September 18. Walter Areta, Vice President of the Natural Rock Asphalt Corporation, will serve as Vice President of the Institute, and W. N. Bosler, Assistant Sales Manager of the Kentucky Rock Asphalt Company, was elected as Secretary and Treasurer. The following will serve as the first Board of Directors: Rodman Wiley, Sales Manager of the Kentucky Rock Asphalt Company, Phil McGovern, Sales Manager of the Ohio Valley Rock Asphalt Company and G. C. Appleton, Chief Engineer of the Natural Rock Asphalt Corporation. A. H. Hinkle, former Deputy Highway Commissioner of Ohio and later Superintendent of Maintenance for the Indiana State Highway Commission, was appointed Executive Director.

THE WATER WORKS ENTERTAINERS

STANDING, Left to Right: Joe M. Wafer, Industrial Chemical Sales Co.; Rudy Lowe, Proportioneers, Inc.; George Hagetter, W&T Co., Inc.; E. J. Reilly, W&T Co., Inc.; J. J. Butler, Jr., Industrial Chemical Sales Co.

SEATED, Left to Right: Geo. D. Norcom, Federal Water Service Co., N. Y. C.; Mrs. Rudy Lowe; Wm. J. Orchard, W&T Co., Inc.; Miss Anna Reichl; Clinton Inglee, National Water Main Cleaning Co.

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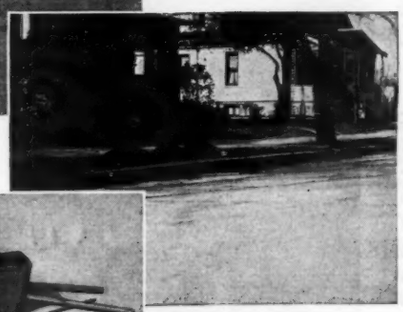
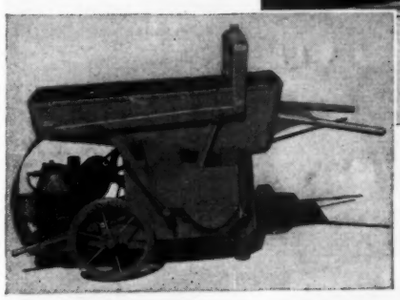
Curb and gutter depression before application of Mud-Jack Method



No. 10 N. E. C. Mud-Jack



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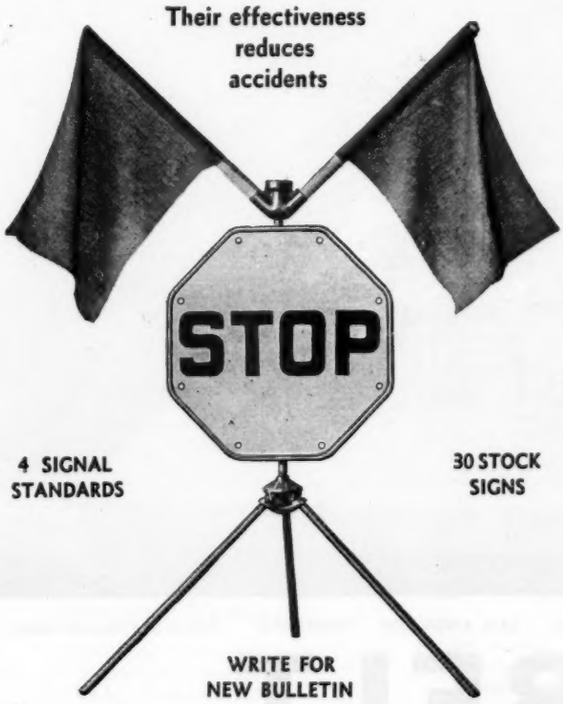

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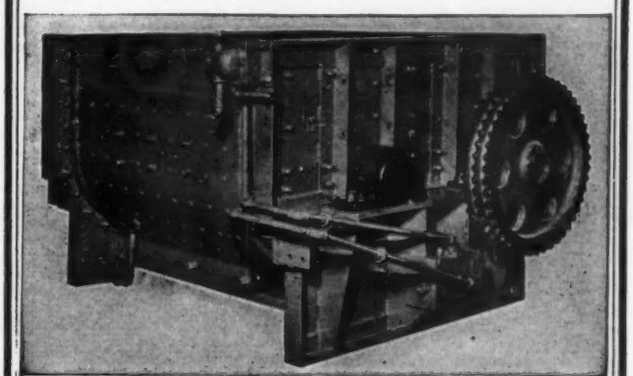

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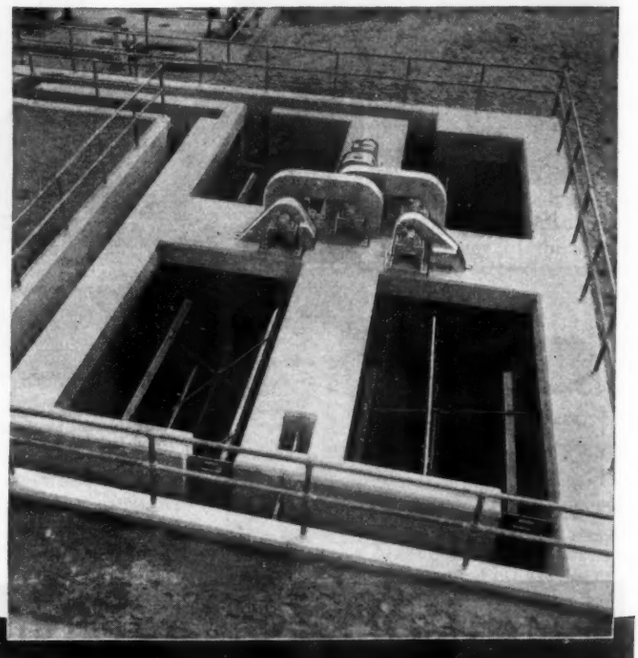

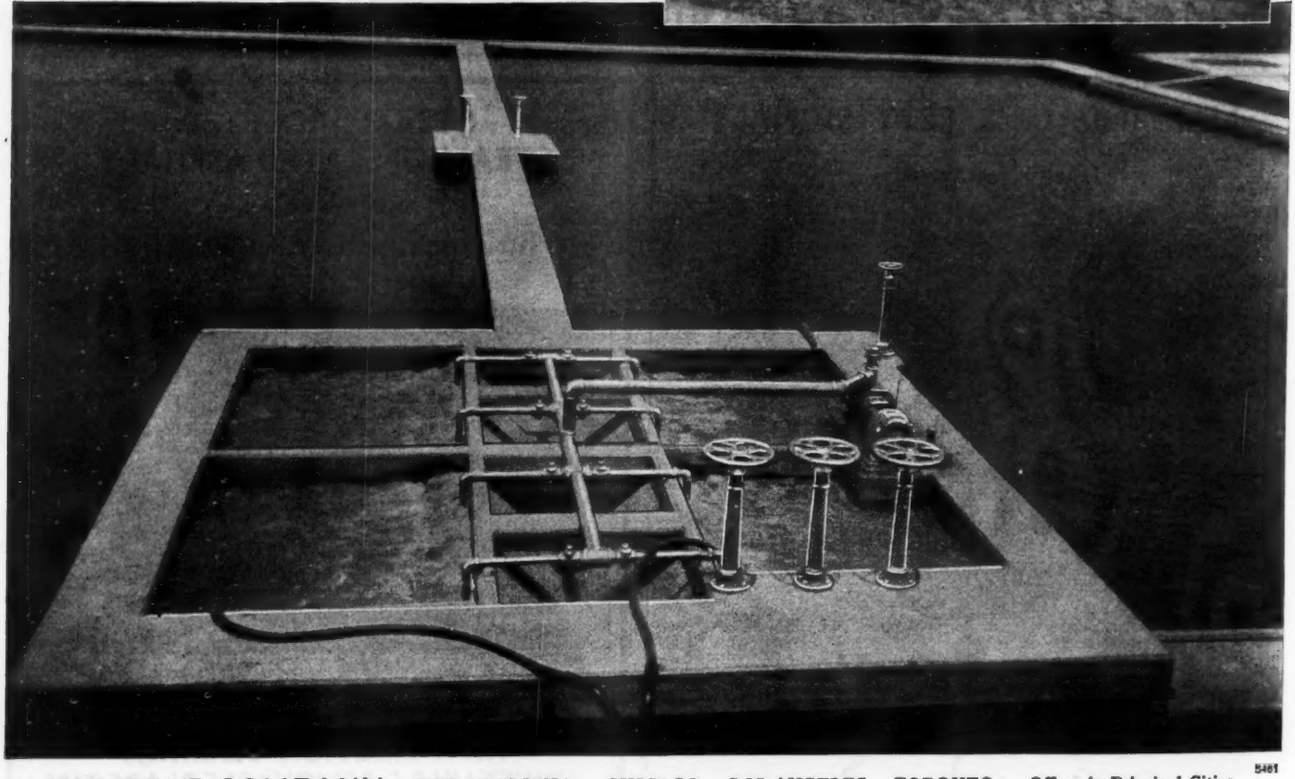

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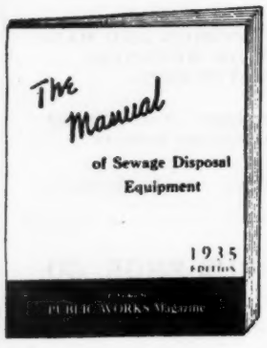

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State of New York } ss.
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Before me, a notary public in and for the State and county aforesaid, personally appeared J. T. Morris, who, having been duly sworn according to law, deposes and says that he is the Business Manager of PUBLIC WORKS and that the following is, to the best of his knowledge and belief, a true statement of the ownership, management (and if a daily paper, the circulation), etc., of the aforesaid publication for the date shown in the above caption, required by the Act of August 24, 1912, embodied in section. ???, Postal Laws and Regulations, printed on the reverse of this form, to wit:

1. That the names and addresses of the publisher, editor, managing editor, and business managers are: Publisher, Public Works Journal Corp., 310 E. 45th St., New York, New York; Editor, A. Prescott Folwell, 310 E. 45th St., New York, N. Y.; Managing Editor, None; Business Manager, J. T. Morris, 310 E. 45th St., New York, N. Y.

2. That the owner is: (If owned by a corporation, its name and address must be stated and also immediately thereunder the names and addresses of stockholders owning or holding one per cent or more of total amount of stock. If not owned by a corporation, the names and addresses of the individual owners must be given. If owned by a firm, company, or other unincorporated concern, its name and address, as well as those of each individual member, must be given.) J. T. Morris, W. A. Hardenbergh, Croxton Morris, S. W. Hume, A. Prescott Folwell, S. N. Hume, all of 310 E. 45th St., New York, N. Y.; Wesley Hardenbergh, Golf, Ill.

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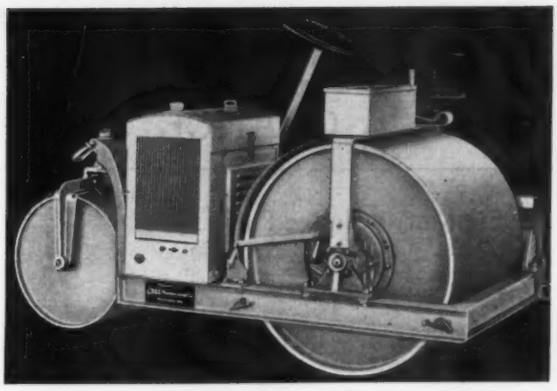
5. That the average number of copies of each issue of this publication sold or distributed, through the mails or otherwise, to paid subscribers during the twelve months preceding the date shown above is..... (This information is required from daily publications only.)

J. T. MORRIS,
(Business Manager).

Sworn to and subscribed before me this 1st day of October, 1935.
(Seal) CROXTON MORRIS.

NOTARY PUBLIC, WESTCHESTER COUNTY, N. Y. Cert. filed in N. Y. Co. No. 923, Reg. No. 7M562 Commission expires March 30th, 1937.

For WPA Projects



The C. H. & E. Roller is well suited to many WPA jobs

Equipment for Better Winter Construction Work:

Unemployment relief projects must be carried on in winter weather during the next few months. With proper equipment, work of many kinds is possible. Littleford Bros. have just issued a folder describing various items of equipment especially designed for aiding in good winter construction. Among these items are the concrete heater unit, which will heat concrete mixtures to the proper pouring temperatures, and helps proper setting of concrete in cold weather; the oil-burning water heater which supplies hot water for concrete mixing and other purposes; the torch burner for all kinds of heating, thawing and drying; and the salamander or oil-burner for a variety of jobs. Write Larry Glaser, 452 East Pearl St., Cincinnati, Ohio, or the Editor of PUBLIC WORKS for full information on any of these.

New T. L. Smith Mixer:

The T. L. Smith Company has added a four-wheel end discharge, 10-S. The new machine, unusually compact and light in weight, combines the advantages of the two-wheel end discharge model with four-wheel truck stability. Only 6½ ft. wide, it is ideal for work in narrow places.

The unique truck design of this new 10-S machine, provides for a 5 ft. wheel base. Fast towing speeds are possible. Engine mounting on the right side avoids overhang on the traffic side. The telescopic tow bar folds back while mixer is in use.

A new vertical syphon type water measuring tank with calibrated gauge is accurate to - the - ounce. Measurements are not affected by variations in water pressure.

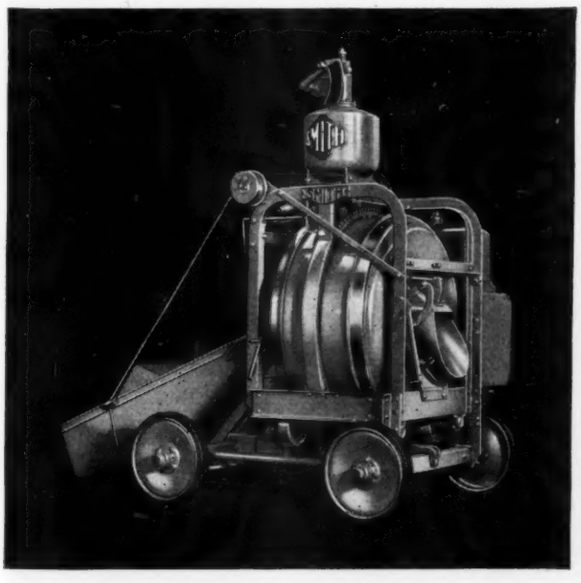
C. H. & E. 2-Ton Roller:

This new 2-ton roller has been developed for use in rolling sidewalks along highways, playgrounds and various other types of light rolling work in conjunction with the larger public works program now getting under way. It is also very handy for light patching on roads and streets.

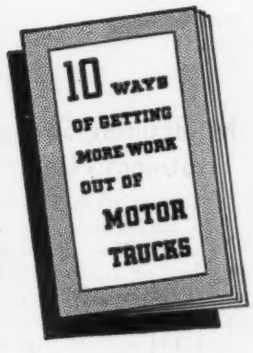
This roller is very simple in construction and therefore is very economical in operation, as there are no complicated parts to cause trouble. Write J. H. Hase, C. H. & E. Mfg. Co., 120 East Mineral Street, Milwaukee, Wis., for complete catalog.

An All-Purpose Tool for WPA Work

A portable gasoline hammer, manufactured by Barco Mfg. Co., 1807 Winnemac Ave., Chicago, Ill., is very useful in WPA and in other municipal construction work. It is of especial value in digging in frozen ground, drilling, driving piles, tamping backfill, breaking concrete and similar work. This hammer, which weighs only 89 pounds, can be handled easily by one man; its use eliminates the necessity of having an air compressor on the job, and it can be moved easily and quickly from one job to another. The only parts aside from the hammer itself is a battery box. A lot of useful information on this type of work is given in catalog 600, which will be sent on request to the company at the above address.



The New T. L. Smith Mixer



Yours for the Asking

Hoists & Truck Bodies:

A mighty nice catalog listing trucks, hoists and bodies, with some remarkably low prices, can be obtained from Anthony Co., Streator, Ill. Especially adapted for smaller trucks on street and road work, ERA work, etc.

Underbody hydraulic hoists, Bulletin 2; hoists, dump bodies, and hi-lift units for 1½-ton units, Bulletin 7; garbage and rubbish bodies, Bulletin 12, describes units used in various cities and towns; Wood-Mead Morrison winches and pole derricks, Bulletin W1A; power takeoff data for motor trucks, Bulletin W2A; electric car puller units, Bulletin W3. Any or all can be obtained from Gar Wood Industries, 7924 Riopelle St., Detroit, Mich.

FWD 1½-Ton Truck:

A twelve page booklet on the Model HS, 1½ ton truck has just been issued by the Four Wheel Drive Auto Company, Clintonville, Wisconsin. The booklet, through timely illustrations and descriptive detail, points out the capacity of this unit for performance, speed and economy. Copies on request.

Small Power Shovels:

American Hoist & Derrick Co., St. Paul, Minn., has issued a new catalog, very well arranged, describing its new Model 350, ½-yard crawler type shovel-crane-dragline for gasoline, diesel or electric operation.

Working Motor Trucks Harder:

A 16-page booklet on truck management, contains graphic charts and a discussion of routing, scheduling, how to check speeding, overtime, delays, and such matters. Of course it involves using a truck you have to buy, but these folks seem to have made a pretty fair case. Anyway, the booklet is full of sound sense and good ideas. Free on request to Service Recorder Co., Cleveland, O., who may, after all, be able to show you some new ways to save money on truck operation.

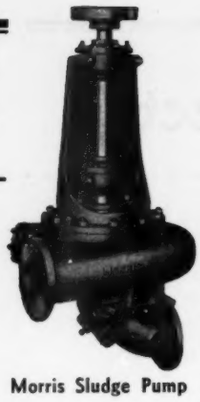
NEW EQUIPMENT AT A GLANCE

A New Morris Sludge Pump:

A non-clogging pump for handling sewage or pulpy materials at high speeds and against high heads, has been developed by Morris Machine Works, which permits the use of standard high-speed motors.

An exclusive feature is the floating suction ring which is designed so that solid particles will not interfere with its effectiveness as a seal between the suction and pressure parts of the pump. The impeller of each size will pass solids up to 1 in. smaller size than the pump outlet. Efficiencies above 85 per cent have been obtained in several installations.

The new units are built both vertical and horizontal, in sizes from 3 to 10 in., with open or enclosed impellers. Further information can be obtained by addressing Morris Machine Works, Baldwinsville, New York.

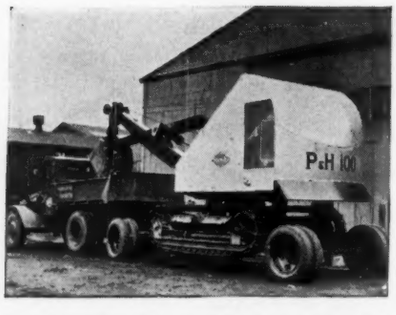


Morris Sludge Pump

Snow fence, properly installed, prevents snow from drifting into roads. This illustration shows the Northfield Iron Works, Northfield, Minn., snow fence. This is an iron fence, easy to install and handle

Side-Suction Centrifugal Pumps:

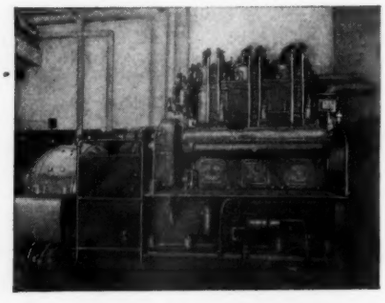
Higher efficiency in capacities up to 450 gpm. and heads up to 100 feet were the objectives in the design of the new Gardner-Denver side suction centrifugals. The blade angles of the impellers are the result of tests and experience over many years. To maintain the harder outside skin of the impellers, a minimum of machining is done, smoothness being obtained by a special foundry process. An adjustable thrust bearing takes up the wear. Full data are contained in a new booklet, which also gives a good deal of handy hydraulic data, including friction of water in pipes. Write Gardner-Denver Co., Quincy, Ill., for a copy which will be sent on request.



The Bantamweight trailer shown herewith is designed as a light and efficient unit for carrying around the P & H Bantamweight excavator, which was introduced earlier this year by the Harnischfeger Corporation, Milwaukee. Has a turning radius of 30 feet; takes 10 minutes to load or unload. With this unit you can take your shovel here, there and everywhere to pick up those small jobs that mean money. Description on request.

Starting Unit for Gas and Diesel Engines:

A new fast-working single-stage air compressor for starting gas and Diesel engines, capable of filling a tank of six cubic feet capacity up to 200 pounds pressure in five minutes or up to 250 pounds in nine and a half minutes, is now offered by The Cooper-Bessemer Corporation. The bulletin announcing it points out that the efficiency of a small machine may be as important as that of a large one—if the larger depends on the smaller to set it in motion; and no satisfactory performance can be obtained from an ordinary small air compressor put into air-starting service. Such compressors, being designed for about 100 pounds pressure, as a rule, are naturally far from efficient at the higher pressures required for starting gas and Diesel engines.



Cooper-Bessemer Starter

A full description of the GX3A can be had by addressing the manufacturers, The Cooper-Bessemer Corporation, at Mt. Vernon, Ohio, Grove City, Pa., or any of its branch offices.

Maintaining Sewage Treatment Plants:

A folder which gives explicit directions for maintenance of sewage treatment plants, so far as painting and protection of concrete and metal is concerned. Where to use paints or coverings, for what purpose, and what to use are covered. Sent on request to Inertol Co., Inc., 401 Broadway, N. Y.

All-Wheel-Drive Ford V-8 Truck

Marmon-Herrington announces the application of its all-wheel-drive principle of design and construction to the Ford V-8 truck.

By installing specially-designed driving front axle and propeller shaft, a two-speed auxiliary transmission and other necessary parts, the Marmon-Herrington Company has developed an all-wheel-drive truck, retaining intact the remainder of the Ford V-8 truck just as it comes from the factory.

The Marmon-Herrington Company has started production on four models. Two are four-wheel-drive units, and two are six-wheel-drive units. The four-wheel-drives have a maximum gross capacity of 13,200 pounds and the six-wheel-drives a maximum gross capacity of 22,000 pounds.

Improved Pipe Wrench Has Cross-Locked Jaw

An improved pipe wrench has been announced by the Walworth Company, 60 East 42nd Street, New York. A renewable lower jaw of hardened steel, with cross tongues seating into cross slots in the handle, is locked in place so as to eliminate backward shear on its pin and prevent loosening in service. The jaw can be easily renewed when required.

The wrench is of drop-forged steel with its housing forged integral with the handle, heat treated for maximum strength. Complete specifications, sizes, etc., may be obtained from the manufacturer.

A Nifty Walworth Wrench